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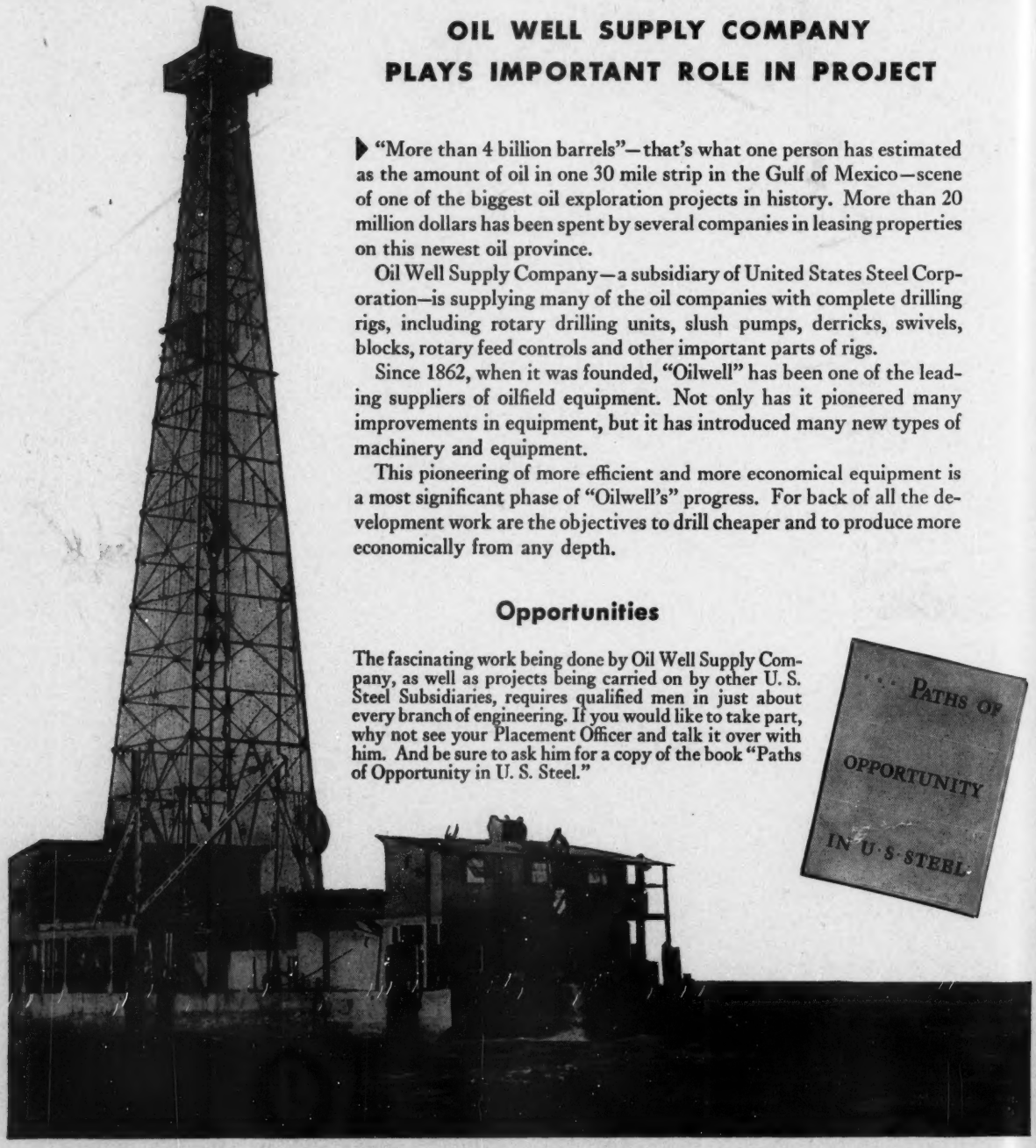
Gulf of Mexico is site of newest oil "boom"



OIL WELL SUPPLY COMPANY PLAYS IMPORTANT ROLE IN PROJECT

"More than 4 billion barrels"—that's what one person has estimated as the amount of oil in one 30 mile strip in the Gulf of Mexico—scene of one of the biggest oil exploration projects in history. More than 20 million dollars has been spent by several companies in leasing properties on this newest oil province.

Oil Well Supply Company—a subsidiary of United States Steel Corporation—is supplying many of the oil companies with complete drilling rigs, including rotary drilling units, slush pumps, derricks, swivels, blocks, rotary feed controls and other important parts of rigs.

Since 1862, when it was founded, "Oilwell" has been one of the leading suppliers of oilfield equipment. Not only has it pioneered many improvements in equipment, but it has introduced many new types of machinery and equipment.

This pioneering of more efficient and more economical equipment is a most significant phase of "Oilwell's" progress. For back of all the development work are the objectives to drill cheaper and to produce more economically from any depth.

Opportunities

The fascinating work being done by Oil Well Supply Company, as well as projects being carried on by other U. S. Steel Subsidiaries, requires qualified men in just about every branch of engineering. If you would like to take part, why not see your Placement Officer and talk it over with him. And be sure to ask him for a copy of the book "Paths of Opportunity in U. S. Steel."

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UNITED STATES STEEL

Founded 1885

The CORNELL ENGINEER

Volume 14 May, 1949 Number 8

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Cover: Genuine interest is shown by Prof. Katz and daughter as they view a cut-away model during Engineers' Day at Cornell.

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The Financing of Construction Projects

By ELMER B. ISAAK, C.E. '33

YOUR city needs a large new bridge, or an airport, or a civic auditorium.

Where will the funds for construction come from? This may sound like a question for bankers or city treasurers, but engineers have found that frequently it is they who must provide the answers. More and more engineers are being called upon to prove the economic soundness of their projects as well as their physical feasibility.

This increasing activity of engineers is linked to the growing reliance on revenue bonds as a means of financing large public works. Revenue bonds are evidences of indebtedness backed solely by a pledge of expected revenues and not the general credit or assets of the issuing agency. This is the type of bond generally issued by "authorities" or other quasi-governmental agencies which are charged with constructing or administering various types of self-supporting projects. By this device, improvements which can pay for themselves are able to go forward without having to be included in municipal or state budgets, and in this way years have been saved in promoting many vital facilities.

Since the purchaser of a revenue bond is relying entirely on future anticipated revenues for the soundness of his investment, the need for thorough and reliable estimates is evident. Such estimates must evaluate three basic elements:

1. Gross revenues of the project.
2. Operating and maintenance expenses.
3. Costs of construction.

On the basis of these three elements, a financial plan can be prepared which will show the degree to which the project can support itself.

The nature of the three basic items of information which must be determined indicates the need for competent engineering investigations as the foundation for financing.

The necessity for engineering talent in determining construction cost is obvious, and the intimate relationship of engineers to the projects they create usually gives them a working knowledge of operation and maintenance requirements.

Revenue Forecasts

It is in the field of forecasting revenues that special techniques have been developed to fulfill the growing need for estimates which can be relied on and accepted by the investing public.

These techniques for estimating revenues rely basically on the application of engineering principles to the problems at hand. Collection of all existing data is the first task, and frequently a number of previous reports dealing with the pro-

The Natches River Bridge near Beaumont, Texas. The 245 feet span can be raised to a height of 153 feet, giving ocean-going vessels entry to the river.
—Courtesy Westinghouse

THE AUTHOR

Elmer B. Isaak is presently engaged with the engineering firm of Madigan-Hyland, where he has been conducting numerous surveys dealing with the financing of construction projects. Some of his past surveys include the financing of the Triborough Bridge, Bronx-Whitestone Bridge, Marine Parkway Bridge and the Belt Parkway in Brooklyn, San Francisco-Oakland Bay Bridge and others.

During his undergraduate days at Cornell, Mr. Isaak was Editor-in-Chief of the Cornell Civil Engineer '33-'34. In addition to this he was elected to Chi Epsilon and Phi Beta Kappa, to round out an enviable record. The author has just completed a comprehensive engineering and economic survey on the proposed recreational development of the Los Angeles shore line.

Elmer B. Isaak

ject are avilable. Almost invariably it is found, however, that existing information is inadequate for the study.

At this point, a program of original research must be undertaken to ascertain the underlying facts in the situation. If the project in question is a toll bridge or highway, traffic surveys will be required to determine the volume and nature of vehicular flows expected to use the facility. Frequently very valuable information concerning revenue-producing projects can be gained by interviewing people who are familiar with one or more phases of the problem. If a public project is to involve concessions for the sale of food, for example, considerable light on the prospective revenues will be shed by interviews with food concessionaires in comparable activities. Important data can often be provided by managers of various public enterprises similar in type to that under consideration.

Likewise assistance may at times be gained through correspondence, especially if regular statistics on the subject in question are kept. Government bureaus compile data in many fields, and this information must frequently be relied on to establish long term trends and background characteristics. For more specialized information, however, field trips are frequently necessary to obtain satisfactory firsthand results.

The prepared questionnaire can be a most useful tool in eliciting information. In some cases a man who knows the answers cannot be pinned down to specific cases by a general conversation or letter, but he will answer direct questions put to him in written form.

Detailed Analysis

Once all the available information has been collected and the necessary surveys completed, the detailed analysis of the problem can go forward. This usually involves estimates and forecasts of the potential use which will be made of the facility in question. Whether these estimates deal with the number of vehicles over a bridge, visitors to a park or museum, or riders on a transit system, the engineer will have to bring all his ingenuity to bear in utilizing the known facts to arrive at reasonable projections into the future. These cannot be mere extensions of curves, but must take into account the potential reservoir from which the facility's patronage will be drawn, the probable diversion to the new improvement, and every forseeable contingency which will affect the situation. In forecasting future usage, population growth is only one of the factors involved. Another most important one that is not always recognized is "created" patronage induced by provision of a new and superior facility. Judgment will no doubt be involved in evaluating certain elements, but the estimate which will withstand scrutiny is the one which has recognized in some way every factor which is likely to affect the results. Dissenting opinions may be voiced as to the importance of this or that item, but as long as nothing can be shown to have been omitted, the analyst, having given more thought to the subject matter than anyone else, is in a strong position to back his conclusions.

After the forecasts of probable use are completed, it is usually a relatively simple matter to derive the estimated revenues of the project. The unit charges have frequently been fixed or assumed in advance. In other cases they are to be based on prevailing practice, or else arrived at after a comparative study to determine the charges which will yield the greatest revenues. In any case, the rates of charges must be taken into consideration in the use of estimates themselves, as they will have an effect through the law of supply and demand.

Bronx-Whitestone Bridge across the East River, New York City, was built with funds raised by revenue bonds issued on the basis of engineering report.
—Courtesy New York City

Operation and Maintenance Expense

The next step is the determination of operation and maintenance expense for the project. If the agency which is to construct the facility is already operating similar enterprises, little trouble will be encountered in obtaining a reliable budget. Otherwise, a process of collecting information on comparable undertakings will be necessary in order to afford a basis for estimating. Many categories of expense can be successfully evaluated by setting up a hypothetical staff or crew necessary to handle the particular functions. Going rates of wages can then be applied.

Maintenance of paved areas, landscaping and similar items can be estimated on the basis of a unit cost per acre if local experience for a comparable development is available. For such facilities as buildings, utilities, waterfront construction

and other structures, the annual maintenance requirements can be expressed as percentages of construction cost. In addition to year-to-year maintenance, annual allowances should also be made for partial or complete replacement of facilities with limited lives.

After totaling up the estimate of annual expense, it is well to seek out some over-all comparisons with comparable facilities to test the reasonableness of the conclusions. This will help to guard against gross inaccuracies or omissions.

Determining Revenues

At this point, all the elements are present for the determination of net revenues. A table should be prepared showing the annual estimates of gross revenues, from which are deducted the estimates of operation and maintenance expenses. The remaining net revenues are the amounts available to apply against interest and amortization charges.

The revenue determinations give one side of the economic picture of the project. The other side is the cost of getting the project built. Estimating construction costs is a standard engineering problem and need not be discussed here. The estimates for new projects are usually in a preliminary stage, as detailed plans have not been worked out. These estimates should be checked over and reviewed, but they must be regarded as preliminary figures as long as the design is not available. Thoughtfully prepared estimates of this type are usually acceptable for a financial report, but a reasonable margin should be allowed for contingencies. The costs of engineering services, of course, should be included. Proper allowance should also be made for interest charges during construction, as the project will not be earning revenues during this period.

Financial Analysis

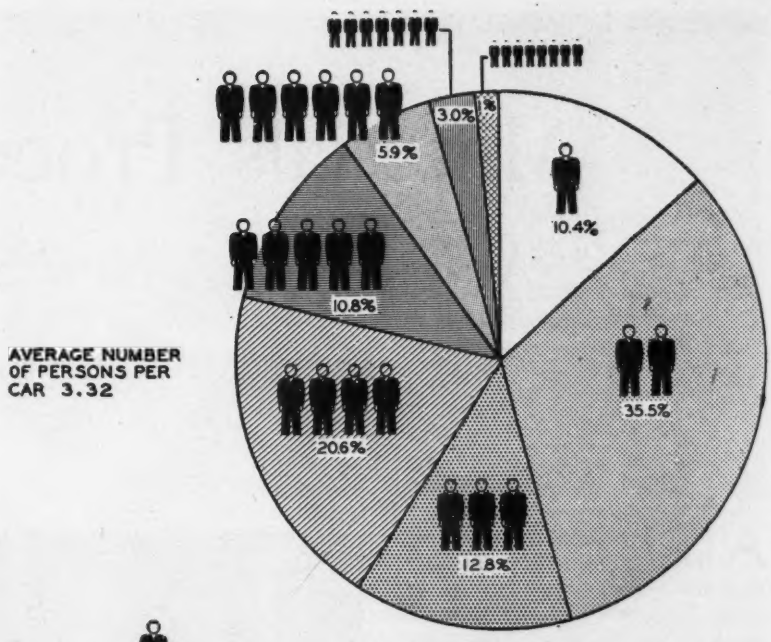
With the estimates of cost and of revenues in hand, it is now possible to analyze the project from the financial standpoint. If the funds are to be raised entirely by means of revenue bonds, the net earnings of the project will be the only source from which the indebtedness can be repaid. Amortization tables must then be worked out showing the manner in which the revenues will take care of interest charges and repayment of the bonds. The results obtained from such tables differ from those which would be yielded by the accounting formulas for retirement of a debt through the annuity or sinking fund methods. Those formulas give annual requirements according to a set pattern, whereas revenue bond repayments should be varied to suit the trend of revenues. Each year must therefore be worked out separately, and the retirements arranged to show the best possible picture.

An important point to keep in mind is that revenue bonds cannot be sold if the anticipated revenues are merely sufficient to pay off the indebtedness within the time permitted. There must be a substantial margin of safety before the bonds become a marketable investment. The term "coverage" is applied to the ratio of estimated net revenues to debt service requirements, including interest and amortization payments. This coverage must generally be from 1.25 to 1.50 to assure favorable acceptance of the bonds, and in some cases an even higher margin is necessary. If this coverage is not shown by the analysis, some form of subsidy is necessary to supplement the revenues.

Innumerable variations exist in the possible financial set-up and the final solution cannot be reached until the investment bankers enter the picture. The engineer's report, however, provides the basic facts essential to the formulation of any financial plan.

In order to visualize the specific application of the principles discussed, a typical example of a survey with which the writer is familiar may be cited.

(*Continued on page 26*)



OCCUPANTS PER CAR	NO. OF CARS OBSERVED	PERCENTAGE OF TOTAL
1	21	10.4%
2	72	35.5%
3	26	12.8%
4	42	20.6%
5	22	10.8%
6	12	5.9%
7	6	3.0%
8	2	1.0%

Graphical representation of statistical material is widely used in engineering reports, in order to clarify the data.

—Courtesy the Author

Materials Processing

An Old Art, A New Science

By PROFESSOR E. K. HENRIKSEN

Photographs Courtesy the Author

A NUMBER of years ago, the teaching of shop methods measured in credit hours was far greater than it is now. The methods employed in the shops were comparatively simple. Today industrial shop methods have developed to a high level, but the total hours of teaching these items are limited, considering the importance of the subject. There is, of course, a natural explanation for this apparent paradox. When industry and engineering were young, engineering as such was an art, not a science, and the center of interest was in the workshops. Many engineers had arisen from the ranks of mechanicians, and it was considered that in order to become a good engineer a man must first be a good mechanician. Hence, the emphasis laid upon workshop teaching. This quite often took a form similar to the teaching of an apprentice.

Operation of a Gang Drill Press, with the aid of a drill jig, in the Production Machine Tools Lab.

Development Traced

There came, however, the period of evolution of engineering science, when the Theories of Elasticity and Statics were developed as the background for the design of structures, and Thermodynamics for the design of prime movers. The center of interest moved to the design departments, and the workshops were considered as being on an inferior level. This development was reflected in college curriculums where the proper scientific subjects moved into the space previously occupied by elementary shop courses.

The outbreak of modern industrial manufacturing methods once more changed the picture, although only partially. Scientific management found its way into the universities and eventually took the form of Industrial Engineering. It was realized that a knowledge of such subjects as Administration, Organization, and Human Relations also must be found in the engineer's mental tool kit.

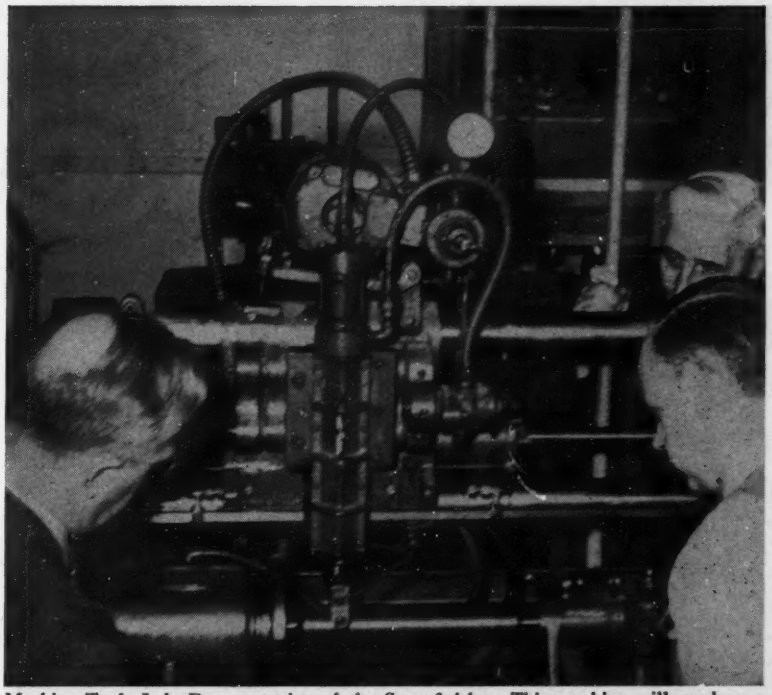
Metallurgy, too, gave its contribution to some very important phases of metal manufacturing processes. All these items, no matter how important and valuable they are for the engineer, do not teach the technical knowledge necessary to perform the operational and managerial responsibilities of the mechanical workshop, which is the core of the machine manufacturing industry. Nevertheless, the modern mechanical workshop of today is one of the finest of technical achievements. This fact is even more remarkable when considering that this technique was built up mostly by men without a college education. They had skill and practical experience which they combined with energy, intelligence, and flashes of real ingenuity. College educated en-

gineers should not forget their debt to these brilliant men.

This progress was made by trial and error, a method which is safe in so far as it certainly will disclose all mistakes and failures, but which also may be tedious and expensive. Today there is in industry a growing understanding of the necessity for introducing into workshops the same engineering principles and methods that are used in other fields. For engineers who are trained in these methods as applied to workshop processes, there is a bright future.

Requisites of Professional Training

The existence of this challenge to engineering education has been realized by its leading men. As a result, we find a great number of universities in possession of a considerable volume of modern workshop equipment. The problem now is, how shall this equipment be utilized to the best advantage. Valuable technical teaching does not always require expensive and refined equipment. Much can be attained in technical teaching by a vivid teacher using chalk and a blackboard. Modern visual aids greatly increase the efficiency of the teaching, and demonstrations of the real thing usually contribute greatly to the result. When a laboratory with equipment in sufficient number is available it is of the utmost importance that it is utilized for the student's self-activity. In order to familiarize him thoroughly with working conditions of machines, tools, and materials he is required to operate the equipment himself. We are thus brought back to the starting point: The shop course.



Machine Tools Lab. Demonstration of the Superfinisher. This machine will produce a surface finish to .00001" or better.

Designing the Course

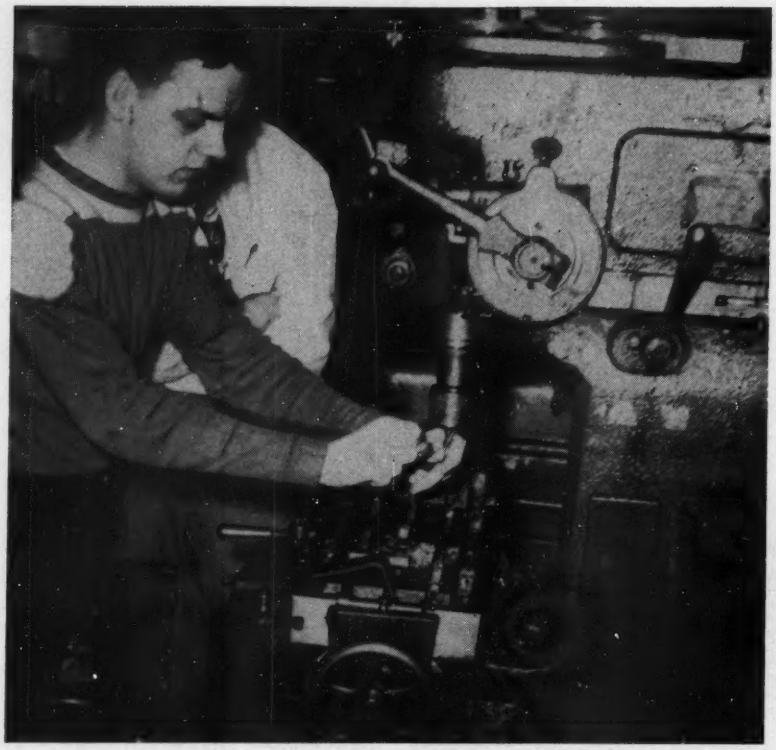
When designing an adequate and efficient shop course within narrow limits of time, it is absolutely necessary to have a clear and definite understanding of the purpose of such a course. When an engineer was considered to be kind of an advanced mechanician the matter was easy. The efficiency of a shop course could be measured by the degree of skill which it was capable of imparting to its students. Although the desirability of a certain amount of manual skill is still acknowledged, it is also generally agreed that skill in itself is only of limited value for the engineer. Therefore, the time in the curriculum is too precious to be spent for this somewhat restricted purpose. The primary purposes

THE AUTHOR

Erik Henriksen

Professor Erik Henriksen is a native of Copenhagen, Denmark, where he received his M.S. in Mechanical Engineering from the Royal Danish Technical University in 1926. From 1926 to 1928 he traveled abroad in Belgium, England, and Germany as a consultant in locomotive work, diesel engines, and steel structures.

In 1932 Professor Henriksen was appointed Associate Professor of Mechanical Engineering at the Royal Danish Technical University, where in the field of Metals Processing, he instructed both undergraduate and graduate students. Since 1938 he has conducted his own machine tools research laboratory, and has provided guidance for advanced students' thesis work in this field. The author of a number of text books, articles, and research papers, Professor Henriksen has done a substantial amount of original work on such problems as machinability, residual stresses in machined parts, and sintered carbide cutting tool tests. Appointed head of the Materials Processing Department in the Fall of 1948, he is busily engaged in introducing a more comprehensive materials processing curriculum to the engineering campus.



Student operation of a Vertical Milling Machine.

of the shop course must be sought in other fields. They are: to give the student the necessary background in manufacturing methods and the processing of materials so that he will have due regard for these factors in the design of factory produced products; to give him an appreciation of the fields of production and industrial engineering so that he may compare them with other fields; to enable the future engineer to understand how objects of the engineering profession are made and to enable him to cooperate with men in the manufacturing field; to familiarize him with available sources of information and thereby enable the engineer to proceed in the study of manufacturing methods if he might wish to do so at a later date, even if he has not chosen this as his special field of interest at college; to enable the student to operate machine tools and perform other shop work to the extent that is necessary when building laboratory projects of his own; specifically for those who choose production engineering and machine tools as their career, to prepare them for this career. These men must not only be qualified for a starting job in the field, but also must receive a broad foundation covering the basic scientific principles. They cannot afford to become lost in the multitude of details encountered in existing machine tools and processes. Such students, through appreciation of engineering principles, may be qualified for leadership, not only in general management of manufacturing departments, but also in the creation of new ideas in machine tools and processes.

Present Courses at Cornell

Materials Processing consists of courses in Pattern Making, Machine Shop and Gage Laboratory. Pattern Making and its place in engineering teaching has been the subject of discussion for quite a number of years. There was a time when this phase was considered to be a handicraft only and rather unimportant for engineers. A survey made at Ohio State University a few years ago by DeWitt Talmadge Hunt, "Shopwork in Engineering Divisions," 1939, indicated, however, a remarkable change in opinion. I believe that pattern making belongs to the very important fundamentals. It is, of course, a necessary pre-requisite for the teaching of foundry practice, but it has even greater significance than this, because it teaches at least some of the decisive fundamentals in the design of machine parts made by the casting process. This constitutes about ninety percent of the bulk of an average machine. Finally, it is a suitable introduction to shop work because it teaches students how to use a tool on the most easily processible material; wood.

Teaching Procedure

In building up the knowledge and skill of the student, the following plan is used. The student is given a machine completely tooled up for a specific job together with blue prints, material and instructions. He is then required to run the machine for a certain time turning out one or several finished parts according to their size and difficulty. He is also required to inspect and check the parts for accuracy and correctness. The object is to teach him how to manufacture useable machine parts or other articles. Then, one or several tools are released from the machine for repair and grinding. This might be performed by the student himself or by the grinding department. The tools are given back to the student and he is required to reset them, continue manufacturing, and check finished parts. This phase of the work is not completed until the machine and its tools are operating correctly. At this time the student is given the same machine, a blueprint, material, instructions and a set of loose tools. He is required to tool up the machine and start to manufacture. In this case, he is required to do all the necessary checking and inspecting. Finally, the student is given a blueprint and is requested to plan the operations for the part shown in the blueprint and to design the tooling for one or more of these operations. If time and conditions permit, he is also requested to carry out a suitable section of the tooling job and to prepare for production.

The course in the Gage Laboratory covers lecture-demonstrations and laboratory practice in the use of all measuring equipment. This

(*Continued on page 32*)

The Race With Sound

By RICHARD E. CHITTENDEN, C.E. '52

A NUMBER of years ago a noted authortiy on aeronautics flatly predicted that with engine-propellor aircraft a speed of 500 miles per hour would never be exceeded. What is more he apparently proved his theory with mathematical formulas and well-founded deductions. In this day and time, however, men are not inclined to accept theory, no matter how well founded. Less than two years later several standard American military aircraft had shattered the 500 mile per hour mark. With the artificial stimulus provided by war, tremendous advances were made in all fields of areonautics. Theories were still respected but never totally accepted.

As a partial result of the impending stalemate, attention was turned to several other sources of power. More money was poured into research on new methods of propulsion and under the pressure of war a great deal of progress was made. Most worthy of mention of these new propulsion principles are turbo-jets and rocket engines.

Beginnings of Jet Propulsion

The British may be given credit for the initial phases of work in most forms of jet propulsion and are far ahead of this country in such development. The turbo-jet is most used at present. It consists of an intake opening which receives air, feeds it to an axial compressor which at once compresses it and raises its temperature. After being compressed, the air is mixed with a low grade fuel, such as kerosene, and ignited in the combusion chamber by means of a sparkplug. This creates excessive expansion, forcing the air through a turbine or set of rotors and exerting tremendous back pressure on the engine and plane. The turbine serves to operate the compressor and furnishes power for the hydraulic system, instruments, etc.

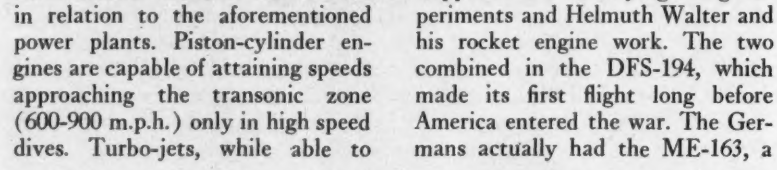
Although much progress has been made in this country with forms of jet propulsion and combinations of propellor and jet driven systems, American engineers have turned to an even simpler and more effective means of power, the rocket engine. It is a pure and simple means of creating a huge amount of thrust for a short period of time with excessive fuel consumption. Its cylinders are merely tubes, open at one end, into which a mixture of liquid oxygen and an alcoholic fuel is injected and burned. The escaping gases exert thrust against the forward wall of the cylinder. This is

Bell xs-1 (now designated x-1) U. S. Army's first truly supersonic plane, end product of the "race with sound."

—Courtesy Bell Aircraft Company

the only engine yet developed that operates altogether indepent of the atmosphere since it carries its own oxygen and there is no need for atmospheric oxygen to aid combustion.

In the race to supersonic speed three definite divisions can be seen in relation to the aforementioned power plants. Piston-cylinder engines are capable of attaining speeds approaching the transonic zone (600-900 m.p.h.) only in high speed dives. Turbo-jets, while able to drive a plane far into the transonic zone, do not have, in their present form, the great amount of thrust necessary to push past the speed of sound into the supersonic areas. Therefore it was natural to expect that some sort of rocket motor would be used to power our sonic or supersonic aircraft.



Exposed view of a Turbo-jet engine which is used in American fighter planes.
—Courtesy General Electric Company

Rocket Development Traced

Contrary to public opinion, the United States was, to say the least, backward in her rocket research. Our engines were certainly not the first to reach the practical stage. We have the Germans to thank for most of our preliminary knowledge in rocket development. Their experiments date back to September 30, 1929, when Max Valier made a successful flight in a rocket powered Opel sailplane, the first rocket powered flight in history. The craft was the work of the German Rocket Society, which was absorbed into the German Army when Hitler came into power, and was produced at Peenmunde, the famed V-2 experimental site. Research work on rockets was accelerated and resulted in the deadly V-2. The first rocket propelled combat plane was a joint effort of Prof. Alexander Leppisch and his flying wing experiments and Helmuth Walter and his rocket engine work. The two combined in the DFS-194, which made its first flight long before America entered the war. The Germans actually had the ME-163, a rocket plane, fully operational over the Continent before the war ended.

Oddly enough, our leading rocket motor has a strangely similar history, though considerably more belated. The leading members of the American Rocket Society formed Reaction Motors, Inc., in 1941. Their research was continued under Navy contract from early 1942 until early in 1948 and resulted in a multiple cylinder rocket motor developing 12,000 h.p. at sonic speed.

Other Problems Encountered

Up to this point only power plants have been mentioned. Many persons wonder why, with a light, cheap, highly powerful engine, the problem of supersonic flight would not be solved. In truth, the development of a suitable power plant was the simplest of all the problems at hand. Without such a source of power higher speeds would perhaps never be obtained, but when it was developed, greater and more complex problems seemed to present themselves. The greatest of these was a thing called compressibility. An explanation of compressibility is fairly simple and is necesesary for an understanding of the problems it was to create.

Pressure Waves

As an object moves through the air it sets up pressure waves which are propagated ahead with the speed of sound. The air is thus "prepared" and begins to flow before the arrival of the object. In uniform, level flight the pressure signal ahead proceeds with sound velocity minus flight velocity with respect to the object. The backward signal travels with a speed equal to the sum of sound and flight velocities. The distribution is not symmetrical, yet every point in space, theoretically, has been reached by the signal. This is not the case in supersonic flight, however. An imaginary cone (Mach Cone) separates the zone of action from the zone of silence, or that area which no pressure signals have reached. At the speed of sound the air ahead has not begun to flow and is not prepared for the object's arrival. The object, say a wing, runs into a "sonic wall' which is no more than air piling up ahead. The air breaks up and goes over the wing in chunks as a repeated series of shock waves. Sonic speed does not have to be reached, however, before the effects will be felt because in traveling over rounded wing or body contours air is speeded up, in accordance with Bernoulli's Law, to the speed of sound. It was calculated that ten times the power would be needed to increase a plane's speed from 500 to 664 m.p.h. as to reach 500 m.p.h. Compressibility, as determined by theories and formulae, would be the greatest problem.

As a direct result of the lack of vital information, engineers turned to a much-used method of exploring air flow and aerodynamic factors affecting objects in flight—the wind tunnel. Only in a wind tunnel could reasonably accurate information be gathered. It is true that other methods were used with moderate success. For example, as airplane speeds reach 450 m.p.h. and upward

toward 500 m.p.h., air passing over the wing frequently reaches supersonic speed. Tiny airfoils, mounted in this air stream and connected with instruments, gave much useful data. Missles dropped from high altitudes reach supersonic speeds, and through the use of telemetering equipment mounted inside the missiles, radar, and photographic equipment, data on drag and airflow were obtained. Still another method was used: rocket-propelled missiles mounting tiny airfoils connected to telemetering equipment inside. The fact remained that wind tunnel data was far more accurate and more easily obtainable.

Wind Tunnel Research

Existing wind tunnels were modified for higher speeds and huge new tunnels were constructed by various aircraft corporations in cooperation with the Government and the National Advisory Committee for Aeronautics. North American Aviation had one of the first of these capable of simulating speeds from 1,850 m.p.h. to 2,500 m.p.h. N.A.C.A.'s new supersonic wind tunnels at Ames Aeronautical Laboratory, Moffett Field, California, are the most complete in this country. Their 1,500 m.p.h. tunnel for operation exclusively above sound speed gives data on design requirements for stable and controllable flight at great speeds. Air pressure and humidity are variable to simulate various conditions. Air flow can be photographed to get details on flow pattern. Even greater speeds can be reached in a nearly completed tunnel at the same laboratory, extending the available range to an extreme of Mach 3.6, or over 2,500 m.p.h. (Mach number is a decimal indicating the ratio of an object's actual speed to that of sound at that particular temperature and pressure.) Several similar tunnels are in use or under construction.

Construction Failures

Further problems presented themselves. An airplane flying 600 m.p.h. was found to be heated by air friction to approximately 64° above atmospheric temperature. At 800 m.p.h. the increase was 114°, 200° at 1,000 m.p.h. Ordinary plastics melt at relatively low temperatures. Aluminum and magnesium alloys lose strength rapidly with a temperature increase. At speeds close to 620 m.p.h. the plastic windscreen of Britain's Gloster Meteor was seen to become deformed. Paint was actually burned from the leading edges of American fighter planes during high speed dives. Cockpits would have to be refrigerated instead of heated, even at high altitudes. Shock waves would jam conventional venturi tubes and air scoops. It was even thought possible that shock waves might create distortion of vision much as do heat waves on a warm day. N.A.C.A. theoretical research indicated the necessity for various radical design changes to eliminate the effects of compressibility and frictional heating. Wing and tail surfaces would have to have knife edges, be extremely thin, and have refrigerated leading edges. Wings would need at least a 65° sweepback to cross the transonic zone and 72½° to fly more than 2,000 m.p.h. With only 45° sweepback and 100 m.p.h. landing speed, the sinking speed would be about 50 ft. per second, twice that safely handled at present by experienced pilots. Another point worthy of consideration is pilot escape in case of emergency. Direct bailout at supersonic speed would be unfeasible for obvious reasons. Methods for preservation of life and comfort at extreme altitudes are also important. Some of these immediate problems were already partially solved; many could be worked out using existing knowledge, but one important type of data was lacking: stability and control, and only one method of obtaining these and certain other data at sonic speed promised accuracy and adequacy: a sonic plane. The Army and the Bureau of Aeronautics were quick to recognize this fact.

XS-1 Moves Into The Picture

Early in December of 1944 the A.A.F. discussed with Bell Aircraft Corporation the possibility of designing a man-carrying supersonic research craft. It would adhere as closely as possible to conventional arrangement and construction in order to prove whether they were practical. A letter contract was signed with Bell on March 12, 1945, calling for construction of three rocket powered models.

Certain requirements were attached to the proposed craft. It was

(Continued on page 36)

The Douglas D-558-2, successor to the Bell X-1, Air Force experimental rocket plane which has succeeded in flying at supersonic speeds.

—Courtesy Douglas Aircraft

1,000,000 WORDS
A MINUTE

Ultrafax
Miracle in Transmission

By GEORGE W. SUTTON, ME '52

ULTRAFAX means simply high speed facsimile transmission. But "high speed" is quite an understatement for the transmission of 30 pictures, diagrams, or pages per second, because at that rate, a million words a minute could be transmitted.

Ultrafax combines four other newly developed processes: television, micro-wave relay, high speed motion picture photography, and "hot photography." To transmit a message by Ultrafax, it must first be photographed onto film, much in the same way that V-Mail was reduced to microfilm before being flown overseas. After developing the film, it passes by a "flying spot" television scanner. The television image thus received is then transmitted as ultra-high frequency radio signals. At the receiving station, the television images are picked up on the kinescope of the receiver in the form of repeating images, one image for each message being sent. As these images flash on the kinescope, they are photographed by a motion picture camera, and then "hot photography," using heated chemicals, develops the film and dries it, with only 40 seconds elapsing between the time the film is fed into the unit, and the time it starts emerging. This film is exactly the same as the one at the transmitting station. Since 30 frames are scanned each second at the transmitter, 30 pictures or pages can be sent each second. The finished film is then fed through an Airgraph continuous enlarger, which blows up the film to full page size on a roll of enlarging paper. The process is completed by developing the paper on an Eastman continuous paper processor, and cutting the finished strips into sheets.

Final adjustments are checked on monitor of Ultrafax sending terminal before start of transmisson.
—Courtesy Radio Corporation of America

Limitations

There are several limitations to the Ultrafax system. First, although Ultrafax transmits at the rate of 30 frames per second, it is obvious that 30 pictures cannot be photographed each second at the transmitting station, nor can 30 frames be printed each second on the continuous paper processor at the receiver, because these two processes are relatively slow. Thus, at every station, a battery of photography equipment would be needed, if the Ultrafax circuit were to be used at maximum capacity.

The second, and greatest limitation is that ultra-high frequency radio waves travel in straight lines. This means that either at every 25 miles between the station there must be a radio relay station, or there must be a coaxial cable between the stations. This entails a huge investment, for the cost of building a network of radio relay stations is about $200,000,000 and the cost of a coaxial cable system is about the same.

But how to get Ultrafax across the ocean is the greatest problem, considering that the waves travel in straight lines. With present technology, there is only one possible solution, that which was suggested by David Sarnoff, president of the Radio Corporation of America, who

sponsored the development of Ultrafax. The only answer is to have a string of airplanes across the Pacific and Atlantic, with each plane carrying the necessary relay equipment. Mr. Sarnoff has further suggested that the Army could take care of the airlift with some of their aircraft not being used, but such a solution is highly impractical.

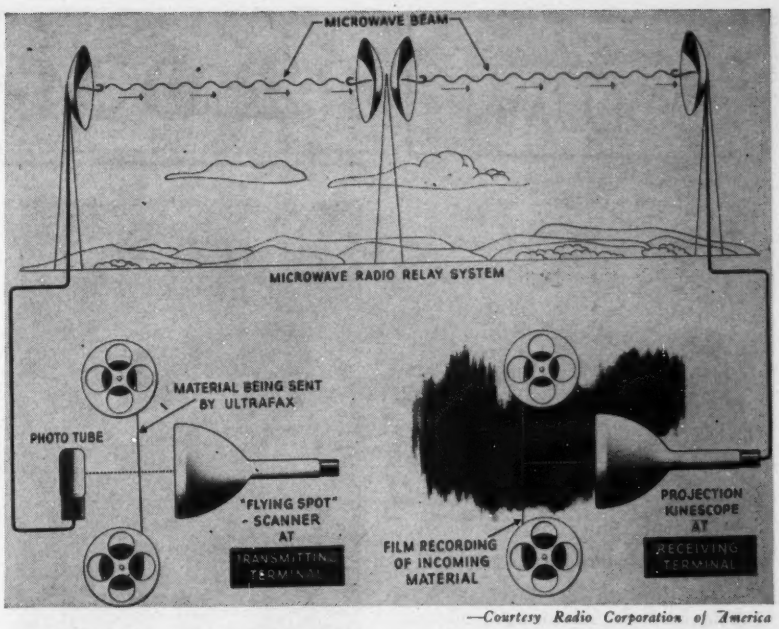
Uses of Ultrafax

It seems most likely that Ultrafax would be used for an entirely new service—a sort of combination of air mail, facsimile reproduction, and telegraph: As such, its uses are almost infinite; for instance, an Ultrafax circuit between two cities can handle 40 tons of mail daily. If we had had Ultrafax during the war, it would have cleared 24 hours of message traffic from the Pentagon in only 60 seconds. The press services, instead of sending their wire photos over a facsimile system which requires several minutes for each photo, could drop their photos off at the local Ultrafax station, and an hour later, a full day's pictures could be on the desk of every subscribing newspaper.

—Courtesy Radio Corporation of America

Preparing for Ultrafax transmission, microfilm recording of messages is placed before flying-spot scanner.

Since Ultrafax is rapid, it could easily replace the telegraph and teletype systems. For example, when you buy a car in New York, the manufacturer does not disassemble the car at Detroit, ship each part separately, and then reassemble the car in New York. Then why break the words in a message down to a series of signal impulses, and send each impulse separately? Why not send the entire message as a unit? In that way, Ultrafax can send diagrams, and foreign languages that are written in characters other than English, which telegraph or teletype could never do.



—Courtesy Radio Corporation of America

Simplified diagram of a complete Ultrafax system showing the principal elements.

Then again, the developed film at the receiving station is exactly the same as the film at the sending station. Motion picture films and newsreels could therefore be distributed in a minimum of time. For such purposes, of course, the enlarging process is not needed.

It seems most likely that Ultrafax will develop into a super-communication system that will be used by the military, civilians, the newspapers, the motion picture industry, and possibly by television, since the micro-wave relay system could be used for transmitting television programs when not being used by Ultrafax.

Who Will Operate and Own Ultrafax

$200,000,000 for a relay network is quite a large investment. The first problem to be solved is, who should build the network. It seems most likely that some enterprise already in the communication business will operate Ultrafax. Such a company is Western Union, who already has the facilities for message distribution and collection. To increase their efficiency, Western Union has begun to take down their 1,700,000 miles of wire and replace it with a radio relay system, and has already begun to buy and lease radio tower sites. This network of radio towers across the country could also house the ultra-high frequency relay equipment. Thus Western Union could handle Ultrafax transmission as well as compete with American Telephone and Telegraph Company's coaxial cable for the transmission of television. But the installation of wide band equipment would cost an additional 25

(*Continued on page* 30)

A camera at the Ultrafax receiving terminal records incoming messages on 16mm. film.

—Courtesy Radio Corporation of America

The Editor's COLUMN

Large or Small?

One of the most heated arguments heard at any bull session, in which students from *different* colleges and universities are taking part, concerns the relative merits of the large university and the small college. Usually the reasoning of both sides is slightly prejudiced by loyalty to certain Alma Maters, but still the subject is one worthy of serious consideration.

From those of the small colleges, we hear of the advantages offered by the smaller classes and the closer relationship with the faculty. It is stated that there the student is recognized as a person, and that there he is able to receive a better insight into many subjects by individual contact and consultation with the faculty members.

At about this point in the discussion, the university man steps in to set forth his side of the question. In a large university, we are to recognize that there is an advantage merely in the reputation of its name. And to challenge the argument of the small colleges, it is reasoned that the student in a university has the same opportunity for faculty consideration as in a small college. Every professor and instructor has, or should have, office periods which are reserved for the student's benefit.

But to us, the best argument to arise from such a debate is based on the facilities which the large university is able to offer, both for instruction and research. In the field of engineering, for example, a small college has not the funds with which it could put a synchrotron into operation, or open a modern soils-testing laboratory for student instruction. The experience that can be derived from the use of such facilities is a necessary supplement to textbooks; in this respect, the large university can better meet the requirements of an education in any field.

PROMINENT

Rog

Roger E. Thayer, EE

There was never any doubt in Roger Thayer's mind what he wanted to do when he graduated from high school. Living in Ithaca all his life, it was always his ambition to come to Cornell. The fact that his father owns an electrical appliance store and that he has been fixing radios and other electrical equipment for as long as he can remember probably accounts for his being a senior in the EE school today.

Rog graduated from Ithaca High in June, 1944, and entered Cornell in November. While still in high school, he enlisted in the Aviation Cadet Program and in April, 1945 the Air Corps called him to duty and sent him to Remote Control Turret School at Lowry Field, Colo. Then, after the war was over, the army closed the program down and he got his discharge in November, 1945, returning to Cornell the following March.

Rog is in the power option in the EE school but he is taking all his electives in electronics because he plans to go into design and development of electronic control equipment after he graduates.

Outside of engineering, music is Rog's main interest, and he has been a member of and participated in just about every musical organization on the hill. He plays the saxophone and bass viol, is president of the Men's Glee Club this year and has been in the Big Red Band for four years. He has also been in the Concert Band, the Orchestra and the Clef Club.

After Rog returned from the army, he pledged Tau Kappa Epsilon and served as vice president last year. He is also in Tau Beta Pi, Eta Kappa Nu and Phi Kappa Phi, not to mention six terms on the Dean's List.

Last summer he worked in the radar lab at General Electric, Electronics Park in Syracuse. Rog is sure that that is the type of work he would like to go into and he is now trying to decide which company is going to get the benefit of his talents.

Eugene L. Hofmann, ME

If a tall smiling blonde, whom you remember as a counselor from frosh camp, appears in East Sibley and claims to be your descriptive geometry or machine drawing instructor, it is probably Gene Hofmann. And if he sports a "beat up old hat" and seems to be in love with his work, it is a 100% certainty.

Gene

ENGINEERS

Gene was born in Pittsburgh, Pennsylvania, and grew up as his family moved around from Pennsylvania to Indiana, Ohio, Washington, D.C., and finally to Garden City, Long Island, where he attended Garden City High School. Gene competed on the track, cross-country, and rifle teams in high school, and was elected in his senior year to the National Honor Society.

Having decided on mechanical engineering as a career, he looked for a "good engineering school, preferably in New York." He enrolled in Sibley in Fall '45, after deciding that Cornell filled that order.

(*Concluded on Page* 40)

William S. Hansen, ME

Rumor has it that the reason Bill Hansen is always found shrouded in a dense cloud of cigar smoke is that he is just homesick for Ben Avon, a suburb of smoky Pittsburgh. But in spite of the haze constantly hovering over him, Bill is far from being in the fog.

After graduating Cum Laude from Mercersberg Academy in 1945, Bill scouted around for a good engineering school, preferably in the East. Notwithstanding the entreaties of his father—a University of Michigan alumnus—Bill finally selected Cornell where he enrolled in Administrative Engineering in Mechanical Engineering, and has been happy over his choice ever since.

Bill

While preparing himself for his future profession, Bill has sought to develop his all-around abilities by energetically participating in extra-curricula activities. Indicative of his executive ability is the wide range of offices he currently holds. After serving as corresponding secretary of the mechanical engineering honorary society Pi Tau Sigma, this January he was elected president. At the same time he assumed the office of Business Manager of the ENGINEER, culminating his three years of continuous service. Starting as a Business Board compet in his sophomore year, Bill worked up to Circulation Manager last spring. His Sigma Nu fraternity brothers, also recognizing his abilities, elected him their corresponding secretary and chaplain. Bill also belongs to Kappa Tau Chi, the AEME honorary, and is treasurer of Wagon Wheels.

For relaxation Bill loves to give out with a little harmony—barbershop quartet style. While at Cornell he has had an opportunity to display his vocal talents as a member of the Glee Club and as a song leader at Freshman Camp. But it is indisputable contention that his singing is most inspired when he has "a mild, refined cigar" in one hand and a glass of scotch in the other.

Last summer Bill worked as a process recorder around open-hearth furnaces, where he gained some valuable experience and also strengthened his conviction that his destiny lies in production engineering. After graduating he plans to head back to Pittsburgh, which is —in his words—"the land of engineering opportunity." But wherever he goes, Bill takes with him from his Cornell colleagues the best wishes for his future success.

Wendy

Wendel F. Kent, CE

Turning the spotlight on the June graduates in civil engineering, we found Wendel Kent, and despite his modest protests, we collected enough information to land him in in this column.

Home to Wendy is Champaign, Illinois, site of the University of Illinois. But on graduating from Champaign High School in 1942, that natural urge to "fly the coop" and operate at last outside the range of parental authority brought him east to Cornell. The son of a contractor, his interest and natural ability in engineering led him to the School of Civil Engineering.

But his stay at Cornell had scarcely begun before the mass exodus of the Enlisted Reserve Corps in April 1943 put a new twist in the civil engineering curriculum: a hitch in the Army Ordnance Corps. Three years and a few thousand miles of Europe later, he returned to Cornell for another try at the elusive college education.

Wendy "hasn't done anything" here at Cornell, but we did manage to corner him at the Phi Delta Theta house and twist his arm till he confessed to a few activities. As proof that he is not lost without a slide rule in hand, the Cornell Sun knew him as business manager in '47-'48. Subsequently he has served as president of Quill and Dagger, senior honorary society. Membership in Tau Beta Pi, the engineering

(*Continued on page* 40)

Engineers

By ALFRED BLUMSTEIN, EP '51

Engineers' Day, April 23, back on the Hill for the first time since 1941, saw about three thousand visitors pass through the doors of the engineering buildings to view over one hundred demonstrations and exhibits. The guests of the engineers were very much pleased with the show, and their only regrets were that they did not have the time to see all the exhibits being presented.

The demonstrations were intended to show the more glamorous and spectacular side of engineering, and from the opinions of the visitors as they left, these objectives were satisfied.

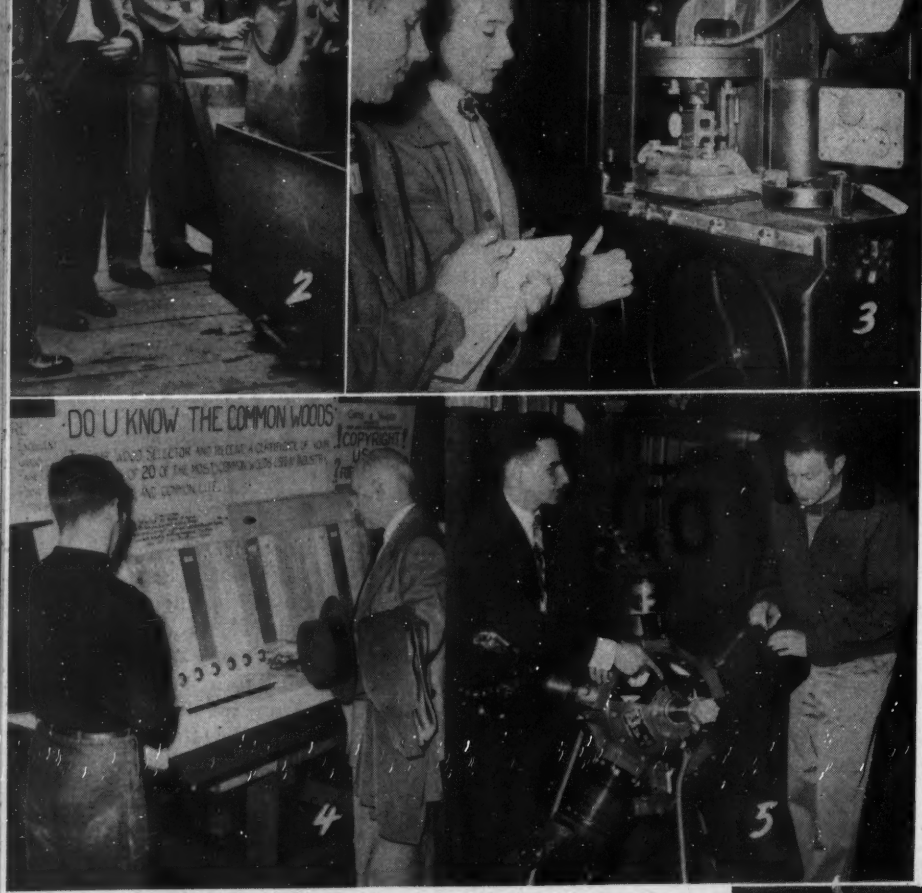
The electrical engineers presented a group of demonstrations which showed various photoelectric and other electronic effects, synchronous motor phenomena, microgroove recording, a speech scrambler, and color and light effects. At the microwave astronomy lab, the sun was tracked across the sky.

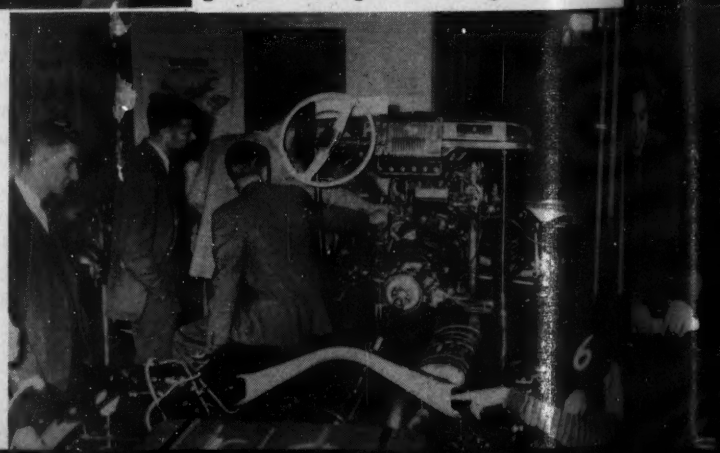
In the Sibley School of Mechanical Engineering, demonstrations were presented in materials testing and processing, industrial engineering, and the photoelasticity method of stress analysis.

Students in the School of Civil Engineering gave exhibits in the fields of structures, administration, sanitation, hydraulics, and transportation.

Guests who took a squint through the proper transit in the exhibit on the development of surveying instruments were surprised to find it focused on a rather attractive photograph strategically placed in one of the trees behind Lincoln Hall.

Members of the College's newest division — Engineering Physics — guided their guests through the





1. Contestants in the Fuertes Memorial Speaking Contest held on eve of Engineers' Day are from left to right: Robert F. Neu, ChemE '50; Robert E. Miller, ME '49; Donald D. Haude, CE '49; John W. Darley, Jr., EE '49, the winner; Prof. J. E. Perry, presiding; David C. Purdy, ME '51; Joseph L. McGinnis, CE '49; Scott D. Hamilton, Jr., Arch '51.

2. Pelton wheel being demonstrated in the Hydraulics Laboratory.

3. New universal soil-testing machine is observed in the Civil Engineering laboratory on Forest Home Road.

4. Wood selector in Pattern Shop gave visitors a taste of engineer education.

5. Pointing out the model of a 150 HP Kinner aircraft engine.

6. Cut-away model of a Desoto chassis and engine under close scrutiny by young and old alike in the Mechanical Engineering Laboratory.

7. Explaining the operation of the synchrotron to visitors in the Nuclear Physics Laboratory.

Day - 1949

University's newest building—the Laboratory of Nuclear Studies. They pointed out all the equipment and facilities available, in addition to treating the visitors to the impressive view of the campus and Lake Cayuga from the roof-deck. Students gave an explanation of the operation of the laboratory's 300 mev. synchrotron.

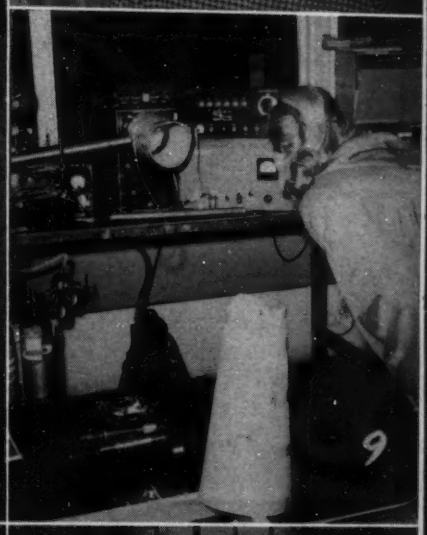
Chemical and metallurgical engineers showed various aspects of foundry operations, microscopy, metallography, and the famous unit operations laboratory.

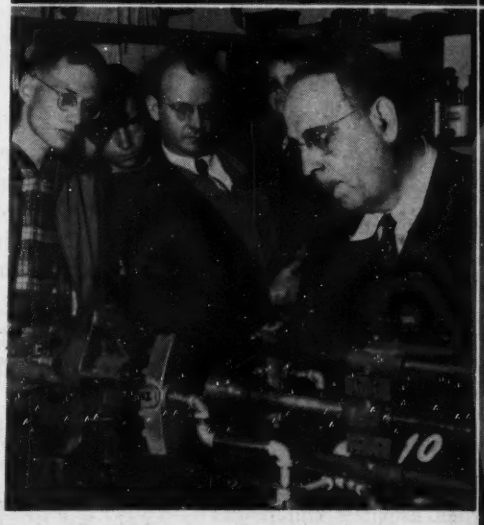
On the night preceding the big day, seven students of the engineering and architecture schools competed in the finals of the Fuertes Memorial Public peaking Contest. John W. Darley, Jr., EE '49, won the first prize.

The Engineering College Softball Championship, symbolized by a two-feet-high trophy donated by the Cornell Club of Maryland, was won by the electrical engineers by virtue of their 14-6 win over the chemical engineers in the final game. Upper Alumni Field, which was graced with thunderstorms, sunshowers, and hailstorm during the course of the afternoon, saw the Delta Club bow to Pros-Ops while Atmos downed Rod and Bob.

The students of the Engineering College are to be congratulated for the excellent job of cooperation and achievement that was displayed in making Engineers' Day a successful event.

Credit also goes to the Cornell Student Engineering Council for the initiation of the program and for the coordination it achieved among the various schools.





8. Tension mounts during a torsion test in the Materials Testing Laboratory.

9. A Geiger counter attracts attention at the engineering physics displays.

10. Prof. W. C. Ballard demonstrating the manufacture of vacuum tube envelopes as part of the electrical engineering exhibition.

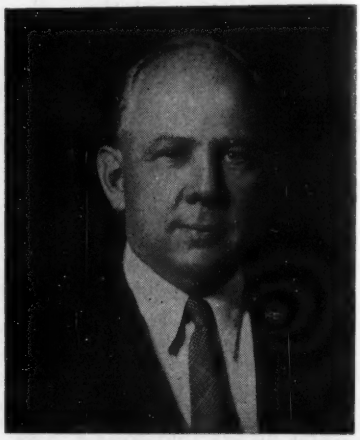
11. Jumping coil experiment fascinates a young visitor in Rand electrical laboratory.

12. High speed (24,000 rpm) of this separation centrifuge in Olin Hall proved a source of amazement to many visitors.

13. Oliver rotary filter in use in the Chemical Engineering unit operations laboratory.

Cornell Society of Engineers

107 EAST 48TH STREET 1948-1949 NEW YORK 17, N. Y.



Creed W. Fulton, M.E. '09

"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University its graduates and former students and to establish a closer relationship between the college and the alumni."

President's Message

In this, my final monthly message, I wish to express some thoughts which are in my mind at this time.

Our society, I believe, has a very real and large opportunity to serve the College of Engineering and its alumni.

This we can do by carrying forward, in an effective manner, the program which we have developed this past year.

What we aim to do, why, and how, are covered in my annual report which is being mailed to all of our approximately 17,000 engineering alumni.

Accompaning that report is one from Dean Hollister which, I feel sure, every Cornell Engineer will relish.

Some 3,000 readers of the CORNELL ENGINEER are now members of our society. To them I express the hope that they will accept the responsibility of helping our incoming officers achieve our major aims and objectives, speedily and effectively.

The society needs your active support in order to do well, and completely, the task we have set for ourselves in our new program.

We are fortunate in having a splendid group of incoming officers and committee members. We have attracted to membership a larger percentage of the graduating class than in an yother year, and we are well on our way in helping our younger graduates, in a tangible manner, bridge the transition years from campus to business.

There is much to be done, but I am confident that under the able leadership of Bill Littlewood, your new president, we shall have a highly successful year in 1949-50.

With your full cooperation and support, we can scale new heights, next year and in the years to come.

In conclusion, I wish to express my sincere appreciation for the opportunity this past year has given me to serve Cornell through the Cornell Society of Engineers, and also to express my gratitude to the members of the Engineering faculty, the leaders of the undergraduate engineering societies, and the staff of the CORNELL ENGINEER for the interest they have shown, and the fine support they have given, in helping develop a forward looking, comprehensive program, which I believe is worthy of Cornell and of Cornell Engineers.

CREED FULTON

Alumni News

James L. Bates, M.E. (E.E.) '03, retired in September as chief of the Bureau of Technical Affairs of the U.S. Maritime Commission. A biographical review issued in August by the government shipping agency in connection with his retirement, after forty-five years in government service, said that he had been responsible for the design of most of the vessels built under the Commission's auspices since its establishment. As a civilian employee with the Navy from 1906-38, Bates was associated with the design of both Naval and merchant vessels, including many of the warships in World War II. Joining the Maritime Commission in 1939, he directed the designs from which 864 merchant-type vessels were constructed in American shipyards, including more than 500 Victory ships.

Louis C. Edgar

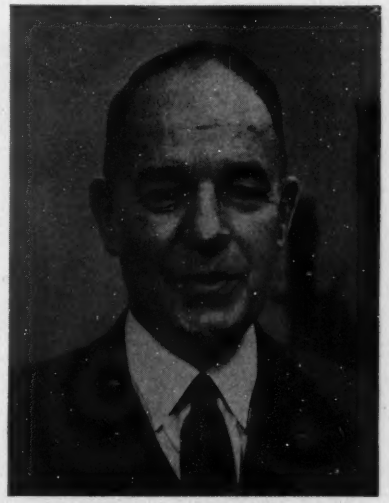
John R. Haswell, C.E. '09, presented the paper "An Agricultural Engineer's Tile Drainage Experience" at the Winter Meeting of the American Society of Agricultural Engineers at Chicago, Ill., December 1948. The article was published in "Agricultural Engineering," the Journal of the American Society of Agricultural Engineers, February 1949. Mr. Haswell is a Professor and Head of the Department of Agricultural Engineering Extension at Penn State College, State College, Pa.

Lawrence Richardson, M.E. '10, consultant to the Boston and Maine Railroad, and assistant general manager of the New York, Susquehanna, and Western, has left for Teheran, to survey Iranian railroad operations and make recommendations as to possible improvement on the railroads of that country. Overseas Consultants, Inc., New York City, the sponsor of his survey, is supervising a $650,000,000 program for development of Iran.

The Cornell Engineer earnestly solicits all newsworthy items about alumni of the College of Engineering. This section of the magazine is designed to be of service in keeping Cornellians in touch and will function well only if the alumni themselves help to keep its columns interesting.

George B. Cummings, B.S. '12, of 79 Front St., Binghamton, was elected a fellow of the Am. Inst. of Architects last March 23 and received the certificate and citation "for achievement in service to the profession in the promotion and understanding of community planning" at the convention of the Inst. in Salt Lake City, Utah in June. On Dec. 1, he was elected regional director of the AIA and on Dec. 13, president of the N.Y.S. Board of Examiners of Architects.

Louis C. Edgar Jr. '33 has been elected president of the E. W. Bliss Co., builders of stamping presses, can machinery, and rolling mills, with headquarters at the Toledo, O., works. At thirty-eight, he is the youngest president since Elphalet W. Bliss founded the company ninety years ago. For the last three years Edgar has been president of the H. & B. American Machine Co.



Lawrence Richardson

Howard H. Sturdy, C.E. '36 has just been named vice-president and director of the Dravo Corporation of Pittsburgh. He was born in Detroit, Michigan, and started as a field engineer with Dravo in 1936, when he received his degree. He was made general manager in 1947.

During World War II, he served as a lieutenant colonel in the Army Corps of Engineers, and was chief of operations and chief engineer of the Third Engineer Special Brigade in the Pacific Area. He was awarded the Legion of Merit and the Bronze Star.

He is a member of the A.S.C.E., the Army Ordnance Association, Army Transportation Association, and the Society of American Military Engineers.

John P. Gnaedinger, B.C.E. '46, has recently become co-owner of a new corporation, Soil Testing Services, Inc., in the business of making foundation borings, run-

(*Concluded on page 48*)

News of the College

Metallurgical Society

The Cornell Metallurgical Society, an affiliate of the American Institute of Mining and Metallurgical Engineers, was organized March 18. The object of the organization is to promote among its members a self-taught increasing knowledge of metallurgical engineering in all its branches and to instil a professional pride in the life work they have chosen.

Application for membership is open to any student in good standing in the school of chemical and metallurgical engineering. Faculty members are invited to become honorary members.

Officers of the society include:

Nicholas Sheptak '51 .....President
Arthur Moon '51 .....Vice-President
Paul Widener '52 .....Secretary
Robert Folkland '51 .....Treasurer

The vice-president serves as chairman of the program committee.

Plant Managers Conference

Seventy plant officials representing more than twenty New York State industrial plants met at a one-day Plant Managers' Conference Tuesday, March 29 at Cornell University.

Sponsored by the Department of Industrial Engineering, the conference was devoted to informal discussions of production, quality and cost control, work simplification, materials handling, personnel management and plant layout.

Alfred M. Staehle, vice-president of the McGraw Hill Publishing Company, keynoted the conference by asserting there is no real reason for a serious economic recession this year. Addressing the group at a dinner in the evening, Staehle declared that industry has spent about 50 billion dollars for plant expansion and modernization to meet demands for low cost operation and yet still possessed "a tremendous amount of obsolete equipment."

Citing the basic industries, he explained that the utility industry needs expanding capacity to meet the nation's power needs. "Appreciable growth," is foreseen by Staehle in the chemical and automobile industries. He indicated that there is "ample room for solid confidence."

The Faculty of the School of Civil Engineering will again be hosts this year at a breakfast for the Civil Engineering Alumni who return to Ithaca for the reunion. Scheduled for Saturday, June 11, 1949, the breakfast will be held in the basement of Lincoln Hall from 7:30 to 10:00 A.M.

The return of this event to the campus in 1948 proved to be one of the attractive features of the reunion. All returning and local C.E. Alumni are cordially invited to attend and make this year's breakfast an even greater success.

Land Planning Degree

A new four-year course of study leading to the degree of bachelor of science in land planning will be introduced next fall in the College of Architecture at Cornell University in place of the five-year course in landscape architecture, which will be discontinued.

Assistant Dean Thomas W. Mackesey said the broader course recognizes the development of "an increasing emphasis on large-scale public and semi-public works—the planning of housing developments and other groups of buildings, parkways and thruways—on a scale that merges with city planning."

Described as the first of its kind in the United States, the program is designed primarily as a preparatory course for post-graduate specialization in landscape architecture or city and regional planning. Upon completion of the land planning curriculum, the student may continue in the Graduate School as a candidate for the degree of master of landscape architecture or master of regional planning.

C.E. Lecture

At a meeting held on March 11th an interesting lecture on "Harbor Engineering" was presented by Professor Donnelly of the Civil Engineering School to the student chapter of ASCE.

Movies, relating the role of the civil engineer to technological progress, were also presented at recent meetings. These movies, covering such topics as highways of the future and aerial photography, have been shown nearly every Thursday this term at 4:30 in Lincoln Hall.

Tau Beta Pi Elections

The following new members were elected to Tau Beta Pi at a recent meeting:

Civil Engineering

Wilson T. Ballard
Edwin G. Cornell
Charles W. Deakyne
Robert W. Gilfillan
Thomas P. Hollowell
Robert N. Holzman
David S. Morgan
Arnold S. Nelson
Paul E. Nickels
Richard C. Sharp
Walter R. Umbach

Electrical Engineering

Khan Chen
James H. Chu
Charles J. Godwin, Jr.
Max H. Kraus
Jerome L. Nishball
James N. Ottobre
Lionel Robbins
Robert C. Rustay
Robert C. Schutt, Jr.
Edward F. Seymour

Architecture

Richard C. Brigham, Jr.
James W. Ellison
Richard B. Frazier
Robert L. Myers
Robert J. Von Dohlen

(*Concluded on page 46*)

Techni-Briefs

Micro Measurement

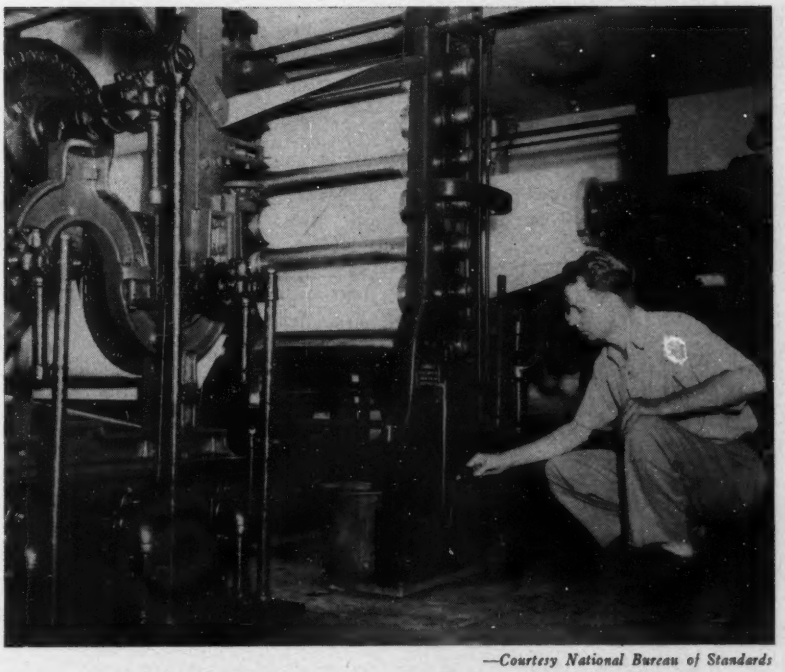
In checking surface finishes, engineers measure to a microscopic degree the amount of surface roughness, using the micro-inch or linear millionth of an inch as a measurement unit. A finely machined metal surface, appearing absolutely smooth to the eye, is disclosed under high magnification as a series of peaks and valleys.

The American Standards Association has provided a written standard for surface designations. However, this written standard allows for four different roughness height ratings. Even though one system of units is agreed on and designation of roughness is therefore standardized, the problem of measuring accurately the unknown surface still exists.

At present, General Motors and Chrysler are cooperating in an effort to produce a set of accurately ruled geometric surface finish specifications which are to act as gage blocks for surface finish measurement similar to the Johansson blocks for dimensional measurement. The use of geometric specimens with suitable roughness measuring instruments will eliminate any doubts an inspector might have as to the roughness of an unknown surface.

The ruling machine pictured below scribes master gold blocks 10,000 lines to the inch.

—Courtesy General Motors



—Courtesy National Bureau of Standards

Paper receives its finish from these rolls by friction and pressure. A workman is shown adjusting the pressure by adding weights to a lever.

Resin Bond Paper

The paper which we handle every day consists of a tremendous number of cellulose fibers which have been cemented together with molecules of water. In other words, they are chemically hydrated. Up to this time, however, only those substances which yield relatively long fibers have been suitable for use in paper making since shorter fibers do not cement together well on hydration.

The increasing shortage of wood pulp suitable for paper making has brought about research which aims at the utilization of the woods which yield short fibers. Most pulp is "beaten" in water to cause the fibers of the pulp to become hydrated, but the Bureau of Standards has developed a resin which will take the place of beating, and which will be the cementing agent in papermaking. This resin is melamine formaldehyde.

Maple, beech, birch, and poplar are the woods which yield short cellulose fibers. At the present moment these trees have been left standing in the forests by the selection of the woodcutters of the trees which are useful for paper making. These trees have multiplied enormously,

(*Continued on page* 42)

Long Playing Microgroove Records

By VICTOR K. PARE, EP '51

Buyers of phonograph records and equipment for playing them have long been painfully aware of the shortcomings of the product, whose specifications were standardized on the basis of recording and reproducing techniques which became obsolete many years ago. Now, however, music lovers who have long winced at the injustices done to their favorite selections by recordings and phonographs are offered relief, not merely by one, but by two greatly improved recording systems currently being offered to the public. It seems appropriate to present here for the benefit of the perhaps confused prospective purchaser a brief description of each system and a summary of the claims made for it.

Acoustical Reproduction

Standard phonograph records of today are well suited to the reproducing equipment of twenty years ago. The acoustical phonograph obtained all the energy available for sound from the vibrations of the needle, so that the record grooves had to be rugged; a needle tip of three mils radius was the smallest usable. In addition, distortion in any reproducing system begins to rise rapidly as the radii of the curves which the needle must follow in the groove become as small as the radius of the needle tip itself. To maintain clear reproduction, then, the successive modulations in the groove must not be crowded too closely; thus the maximum frequency which can be clearly reproduced decreases with the groove speed and with increasing needle size. This factor caused the rotational speed of standard records to be fixed at 78 R.P.M., to maintain decent reproduction at the inner edge of the playing area, about four inches in diameter. This speed and the large groove width limit the playing time of a ten-inch record to about three minutes.

Columbia vs. RCA

Modern reproducing equipment extracts only a very small amount of energy from the vibrations of the needle; hence the needle and groove sizes fixed upon for acoustical reproduction are much larger than are necessary for today's equipment. This fact, in conjunction with the introduction of vinylite plastic as a material, is the basis of the improvements offered by Columbia and RCA in their new records. That the two types of records offered are quite different and cannot be played by the same equipment results from the two companies independently employing the advantage of narrower grooves to work toward somewhat different goals. The difference in these is best exemplified by the two companies' advertising; Columbia's first claim is "Uninterrupted performance . . . up to six times as much music on one record", while at the top of RCA's list of advantages is "Distortion-free music of unprecedented brilliance and clarity of tone." In addition RCA emphasizes that its record equals the longest playing time of a standard 12-inch record, and that it offers a new, efficient changer besides; and Columbia quickly follows up its offer of long playing time with phrases like "The ultimate in realism and fidelity". Obviously, RCA is still concerned with uninterrupted playing and Columbia is by no means forgetting fidelity, but there is a noticeable difference in emphasis.

The new 45 r.p.m. records and automatic changer recently put on the market by RCA Victor.

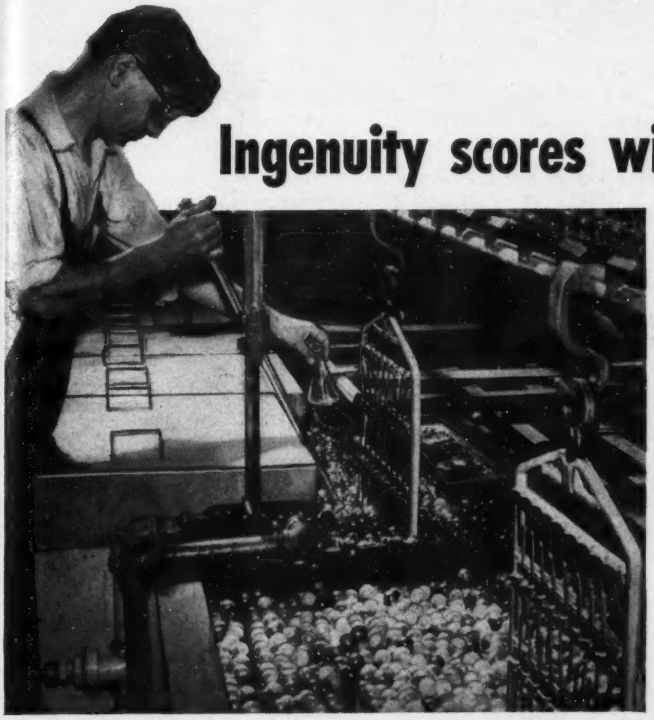
—Courtesy RCA Victor

Columbia Is First

Columbia's microgroove records come in 7-, 10-, and 12-inch sizes, of which the 7-inch are mostly popular records while the 10-and 12-inch sizes are useful for classical music and play, respectively, up to 13 and 22½ minutes on a side. The grooves are 224 or 260 to the inch, and require a stylus of one mil tip radius. These records turn at standard transcription speed, only 33⅓ R.P.M., but because of the small needle diameter, one-third that required for conventional records, their fidelity is considerably greater. The vinylite plastic material is not brittle and hence will withstand more abuse than shellac records, and contains none of the abrasive which the latter contain to grind the needle to the shape of the groove. Because the records are thinner than conventional ones and contain more music, the higher cost of vinylite over shellac is no disadvantage. Storage space for these records is of course very small com-

(*Continued on page* 38)

Newsworthy Notes for Engineers



Ingenuity scores with "Ping Pong Balls"

A novel use of plastic spheres, looking for all the world like ping pong balls, has been made by engineers at Western Electric — manufacturing unit of the Bell Telephone System.

Formerly, when piece parts were immersed in this 45-foot tank to receive protective coats of chromium, the surface of the liquid foamed up—gasses were given off—the solution was dissipated. How to conserve the expensive chromic acid plating solution was the question.

An ingenious answer was found by Western's engineers—special "ping pong balls" made of an almost non-inflammable plastic. With some 10,000 of them crowding the surface, the solution gets little chance to weaken itself by foaming up.

Voice Lifter ➡

Important among recent additions to Bell telephone apparatus is the V-3 Repeater—a combination of two amplifiers used to give weakened voice currents a "lift" on long distance telephone circuits.

When the development of an improved amplifier was initiated by Bell Telephone Laboratories, engineers at Western Electric were asked to help perfect the design for economical production in large quantities. They contributed much to simplified design, planned a new production line, new tools and techniques, new testing equipment. Result: an amplifier 1/6 the size of its predecessor, costing considerably less, and one that—in case of failure—can be replaced in a matter of seconds.

This is another example of how Western Electric engineers help make Bell telephone service the world's best at low cost.

Engineering problems *are many and varied at Western Electric, where manufacturing telephone and radio apparatus for the Bell System is the primary job. Engineers of many kinds—electrical, mechanical, industrial, chemical, metallurgical—are constantly working to devise and improve machines and processes for production of highest quality communications equipment.*

Western Electric

A UNIT OF THE BELL SYSTEM SINCE 1882

Construction Finance

(*Continued from page 7*)

Survey for Bronx-Whitestone Bridge

Several years ago, the Triborough Bridge Authority in New York projected the construction of the Bronx-Whitestone Bridge across the East River. It was evident that the traffic of the proposed crossing would be drawn principally from four sources, as follows:

1. Triborough Bridge
2. Queensborough Bridge
3. College Point Ferry, then operating nearly at the site of the proposed bridge
4. Created traffic.

The first requisite was adequate traffic information on the existing competitive crossings. Complete records for the College Point Ferry were available over a period of many years, and it was evident that virtually all this traffic would use the new bridge, so that presented no problem.

The Triborough Bridge had been in operation only a few weeks at the time. Records of toll collections were available for this period, but they had to be expanded to a full year's estimate. This was done by the use of traffic patterns "borrowed" from other toll facilities in the New York area which had been operating long enough to build up a record.

Determination of the traffic volume using the Queensborough Bridge was a more difficult problem, as no tolls are charged and continuous records were not available. Sample volume counts, in which the vehicles were counted with the aid of traffic clocks, were therefore used as the basis for an estimate. This estimate was again based on traffic patterns developed from the experience of facilities with similar characteristics.

Besides knowing how many vehicles crossed the East River via competitive crossings, it was necessary to find out something about their lines of travel. Surveys designed to determine the origins and destinations of traffic are essential in any complete analysis of vehicular situations, and are particularly necessary when an estimate must be made of the diversion of traffic from one route to another. "O & D" counts are made by a variety of methods, the conventional one being to stop vehicles at selected points and question the drivers on the spot. This requires police cooperation and considerable advance preparation, particularly if vehicles are to be stopped after dark. At some locations, such as at toll booths or even at traffic signals, it has been found feasible to hand drivers a questionnaire printed on a business reply card. When this method is used, replies usually run between 10 and 20 per cent, so that a large enough number of cards must be given out to obtain a representative sample.

Both types of origin and destination survey were used in the problem under discussion, the direct question method being necessary on the Queensborough Bridge, whereas the postcard questionnaire was feasible at the Triborough Bridge toll booths.

(*Concluded on page 28*)

"—The real essence of work is concentrated energy"—WALTER BAGEHOT

Why construction gets better all the time

WHERE ROADS were once built a shovelful at a time... today mammoth earth-movers handle a ton of earth at a time. Mobile cranes swing 20 tons at the flick of a switch. Giant crushers grind 150 tons of rock an hour. Traveling concrete mixers place entire batches as they go.

These are just a few of our improved powered tools of today that do a better job of construction *faster* and *easier*. They help provide us with critically needed new housing and business buildings... with super-highways and airfields for safer, smoother travel. And these tools are ours today because of *better materials*... and continuing research.

Alloy steels, for example, give them greater strength to resist shock and abrasive action... stamina to overcome the strain of day-by-day speed-up demands. And modern oxy-acetylene processes for welding and flame-cutting speed production of these better products of better steel.

Carbon is in the picture, too. In the form of electrodes, it's essential both to the production of alloy steels and the making of calcium carbide... from which comes acetylene gas for welding. Also, a chemical known as an *amine* provides a wetting agent for asphalt... speeding construction by making the asphalt stick more easily and firmly to its crushed rock base.

The people of Union Carbide produce these and many other materials essential to today's better building and construction. They also produce hundreds of other materials for the use of science and industry, to help meet the needs of mankind.

FREE: *You are invited to send for the new illustrated booklet, "Products and Processes," which describes the ways in which industry uses UCC's Alloys, Chemicals, Carbons, Gases, and Plastics.*

UNION CARBIDE
AND CARBON CORPORATION

30 EAST 42ND STREET UCC NEW YORK 17, N. Y.

Trade-marked Products of Divisions and Units include

ELECTROMET Alloys and Metals • HAYNES STELLITE Alloys • PREST-O-LITE Acetylene • LINDE Oxygen
BAKELITE, KRENE, VINYON, and VINYLITE Plastics • SYNTHETIC ORGANIC CHEMICALS • PYROFAX Gas
ACHESON Electrodes • NATIONAL Carbons • PRESTONE and TREK Anti-Freezes • EVEREADY Flashlights and Batteries

Construction Finance

(*Continued from page 26*)

An entirely different type of O & D survey is now being utilized in many cities under Public Roads Administration auspices. With this system, the information on travel is obtained by the home interview method, in which a cross section of the population is sampled. This is a very comprehensive type of survey, requiring an entire area to be covered by the interviewers, but it reveals the complete network of travel within the area. New techniques in planning of main arteries are being made possible by the PRA surveys, but ordinarily they are too broad in character to be justified where the problem is estimating traffic at a specific location or locations.

The next type of information required was a comparison of travel times and distances between various points via the existing crossings compared with the proposed crossing. Time and distance runs are clocked automobile trips made for the purpose of comparing alternative routes. The trips are first laid out on a map so that all routes of interest can be selected and their points of intersection marked. Forms are then prepared with space to record the mileage and time readings at key points. The runs are made by a team of two men, one driving and the other recording. The time and distance differentials can then be computed in the office. In the event that part of any route involves future construction, its distance must be scaled and the running time over it estimated by assuming a reasonable speed for the section in question.

Financial Picture

Once the revenue and cost estimates were all in hand, a financial picture could be prepared. Amortization tables showed a favorable ratio of revenues to requirements, particularly since the new project was to be pooled under the same bond issue with the existing Triborough Bridge (for which similar revenue and expense estimates had been prepared). At this point the investment bankers entered the story and worked out a bond arrangement which would be acceptable to investors.

As a final step, the engineers' report was summarized for inclusion in the offering circular for the bonds, which were successfully marketed to make possible one of the greatest bridges of the nation.

It is impossible even to outline in one article the many procedures which may be used and factors which may be involved in the course of an engineering economic survey. Every situation is different and requires an individual solution, to achieve which, both ingenuity and experience must be drawn upon. The purpose of this article will have been served if it acquaints its readers with the general problems and type of work involved in a little-known but growing field of engineering activity.

Modern Techniques Employed by KOPP GLASS, INC. Illustrate Effective Utilization of GAS

ENGINEERED GLASS—produced for signal, technical, and industrial purposes—involves small-batch operations and specialized glass-making practices. At Kopp Glass, Inc., Swissvale, Pa. engineers have applied modern production machinery to these highly technical processes, utilizing flexible GAS for all heating requirements.

As large users of fuel, Kopp executives are concerned with the operating economies made possible by effective utilization of GAS in modern Gas-fired Equipment. But equally important is the automatic controllability of GAS for the varying temperatures used for melting, annealing, tempering, mould heating, in this specialized glass business. The importance of GAS in the Kopp plants is stressed by the wide range of equipment using this efficient fuel—

- 2 pot-type regenerative furnaces
- 2 special heat treating lehrs
- grinding and polishing plate heaters
- 4 day tank furnaces
- 3 annealing lehrs
- 1 mould oven
- 2 pot arches
- 2 ring ovens
- 1 cut-off machine
- 1 trial-pot furnace

In commenting on the use of GAS for heat-processing in the manufacture of engineered glass, supervisor of Equipment J. B. Fullen says, **"The automatic controllability and the speed of GAS are of great importance, but we can't overlook the cost of fuel in our type of operation. That's why we use every device for effective utilization of GAS."**

Molten glass from the Gas-fired regenerative furnace (rear) is placed in the mould for pressing.

Continuous Lehr in which GAS is used for annealing signal and industrial glass products.

You'll find it worthwhile to investigate modern Gas Equipment for heat-processing in glass manufacturing.

AMERICAN GAS ASSOCIATION
420 LEXINGTON AVENUE, NEW YORK 17, N.Y.

Ultrafax

(Continued from page 15)

percent, and it is questionable whether or not Western Union is willing to pay the additional cost.

It seems almost obvious that RCA, who is already in the radiotelegraph business, would want to operate Ultrafax. But David Sarnoff has indicated that RCA would be content merely to build and service the equipment, possibly because of their experience with a home facsimile system, which has never materialized.

The American Telegraph and Telpehone Company constitutes another possibility, because they already have established a coaxial cable system both in the east and in the mid-west, and plan to hook up the rest of the nation in the future.

Getting away from private enterprise, the Post Office Department might be willing to set up and operate the system, as they did with the air mail and V-mail. Perhaps the Army could own the equipment and allow the Post Office to run it. Such a plan is quite possible, but any government decision must depend on other factors.

Government Competition

For one thing, Ultrafax would compete directly with the air mail, which is one of the chief sources of revenue for the airlines. Therefore any reduction in air mail caused by Ultrafax would mean that most of the airlines in the United States would be financially hurt. This might conceivably force them to increase their rates, thus decreasing their traffic. Western Union receipts would likewise be reduced. Thus, the problem of whether or not the government can go into competition with private industry in this way must be solved completely before any governmental decision can be made.

Needless to say, it will be many years before the Ultrafax is in full operation. Besides solving the indicated problems with respect to overseas transmission, ownership, and competition, the system must be financially feasible. It seems reasonable to conclude that the future of Ultrafax depends on industrial leaders and public officials, who must make the next move.

"Madame X" was the code name, during research and development, for an entirely new system of recorded music . . . perfected by RCA.

The remarkable background of "Madame X"

Now the identity of "Madame X", the unknown in a long search for tone perfection, has been revealed. From this quest emerges a completely integrated record-playing system—the first to be entirely free of distortion to the trained musical ear . . .

The research began 11 years ago at RCA Laboratories. First, basic factors were determined—minimum diameters, at different speeds, of the groove spiral in the record—beyond which distortion would occur; size of stylus to be used; desired length of playing time. From these came the mathematical answer to the record's speed—45 turns a minute—and to the record's size, only 6⅞ inches in diameter.

The record itself is non-breakable vinyl plastic, wafer-thin. Yet it plays as long as a conventional 12-inch record. The new RCA Victor automatic record changer accommodates up to 10 of the new records—1 hour and 40 minutes of playing time—and can be attached to almost any radio, phonograph, or television combination. The record *player* ends faulty operation, noise, and cumbersome size. Records are quickly changed . . . RCA Victor will still supply 78 rpm instruments and records.

This advance is one of hundreds growing from RCA research. Such leadership adds value beyond price to any product or service of RCA and RCA Victor.

Continue your education with pay—at RCA

Graduate Electrical Engineers: RCA Victor—one of the world's foremost manufacturers of radio and electronic products—offers you opportunity to gain valuable, well-rounded training and experience at a good salary with opportunities for advancement. Here are only five of the many projects which offer unusual promise:

- Development and design of radio receivers (including broadcast, short wave and FM circuits, television, and phonograph combinations).
- Advanced development and design of AM and FM broadcast transmitters, R-F induction heating, mobile communications equipment, relay systems.
- Design of component parts such as coils, loudspeakers, capacitors.
- Development and design of new recording and producing methods.
- Design of receiving, power, cathode ray, gas and photo tubes.

Write today to National Recruiting Division, RCA Victor, Camden, New Jersey.

Also many opportunities for Mechanical and Chemical Engineers and Physicists.

RADIO CORPORATION of AMERICA

World Leader in Radio—First in Television

Materials Processing

(*Continued from page* 10)

equipment includes practically all types of commercial devices for measurement of sizes, alignments, and forms, from the steel rule to super-micrometer. One set of gage blocks (recently calibrated) are reserved as Masters for comparing our working sets of blocks, which in turn are used on the several Comparator-type inspection devices. These comparators are of latest design, measuring without contacting the surface being investigated.

The advanced teaching in Materials Processes has for its purpose to qualify the engineer for a career in the workshop and machine tools industry. The scope of this work embodies management and top-level operation of machine shops, and creative work in machine tools and processes. The first of these should lead to any metal manufacturing activity. The second might seem to point to the more limited field of machine tool manufacture. Although restricted in volume, this industry is of the utmost importance, being the parent industry for all metal manufacturing activity.

This separation should not be reflected too closely in the curriculum because the two main objects are quite interrelated in many details, and the two careers are not strictly separated. Cutting Tools deals with the action of the cutting tool, chip formation, distortion, work hardening and machinability of materials, shape and angles of the tool, the choice of cutting speeds and feeds, tool wear and tool life, cutting fluids, and surface quality obtained. The Laboratory projects consist of measuring cutting forces in different materials, study of tool wear and surface conditions obtained under varying cutting conditions, comparisons between steel and carbide tools, and the practical conclusions to be drawn from the observations and measurements.

Planning of Machine Tool Operations deals with the principal properties of the various machining methods, the choice between several equivalent methods as influenced by number of pieces, sequence of operations, methods of chucking and fastening, computing, cutting, and operating time, lay-out of tooling, and more special sections such as: screw thread and gear manufacture, tool room methods, high precision work, and automation. The student will study advanced methods in the laboratory. He will be required to do complete planning of operations for various jobs and to make the tool lay-out. He must also calculate cutting speeds and feeds and correlate his calculated figures with data which he finds during this laboratory work.

Research Defined

One of the surprising facts in the development in the Mechanical Industry described previously, is that the present high level has been arrived at with a minimum of research in the modern sense of the word. Consequently, workshop engineering today represents very nearly a virgin soil. Many points of

(*Concluded on page* 34)

And the Termites cheered too!

SMALL WONDER! Wood stands, like those above that are exposed to damp. rainy weather and snow, rate high on the termite menu. In fact, it's safe to assume, all wood is considered fair game by termites.

Dow produces PENTAchlorophenol to protect wood from the termite menace, as well as from decay due to excessive moisture. Wood protected with "PENTA" lasts years longer than untreated wood! "Wherever wood is used, consider the advantages of PENTA-protected lumber" is a phrase of increasing significance to the farmer, home builder and industrialist. The chemical PENTAchlorophenol is also used in the preservation of hemp, jute, and other cellulosic products that are often exposed to severe climatic conditions.

This is but one of more than 500 essential chemicals Dow produces. It has, however, *one characteristic common to all Dow products.* That is its high, uniform quality—a characteristic that has made the name Dow a standard in the chemical industry.

DOW

CHEMICALS INDISPENSABLE TO INDUSTRY AND AGRICULTURE

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

New York • Boston • Philadelphia • Washington • Cleveland • Detroit • Chicago • St. Louis • Houston • San Francisco • Los Angeles • Seattle • Dow Chemical of Canada, Limited, Toronto, Canada

Materials Processing

(*Continued from page* 32)

interest have been arrived at by crude empirical methods only and lack a thorough scientific explanation which might very well lead to further practical industrial progress. Places where research work on these lines is carried out more than occasionally are few. This is even more remarkable when considering that the great pioneer F. W. Taylor was an American engineer and that the American machine tool industry has been leading the world for more than a generation. Since the day of Taylor, who was co-inventor of high speed tool steel and who found laws and relations which partially hold good today, the center of interest in research has been the cutting tools. Although the research activity in this field dates back at least half a century, it is still far from being explored. Partially on account of the development of new tool materials, new methods and changed conditions, but also on account of inherent difficulties.

When viewing the development of physical and technical science, it is agreed that the laws for the behavior of gases and fluids were founded at a much earlier date than equivalent laws for the behavior of solids. With regard to solids, the laws for their elastic behavior were founded and developed ahead of the laws for their plastic behavior. At the present time, the action of the cutting tool is closely related to the physics of solids and to the laws of plasticity. I estimate that physical development as it is today allows us a first correct glimpse of what is happening. For this reason, there is a vast amount of work to be done. This is the only way to create for the machine tools and cutting tools the same scientific background that the prime movers have in Thermodynamics. Another very important phase of research which is essentially undeveloped is the machine tool itself. The research publications on this class of machinery are extremely few. It is my belief that the development of the machine tool has taken place by the method of trial and error more than by the use of any precise physical data.

A Pratt and Whitney Internal Comparator being used to measure the diameter of a Ring Gage to an accuracy of .000020", in the Gage Lab.

Application of even the elementary rules of mechanics and elasticity would lead to the visualization of heretofore unknown facts and relations. This would result in industrial progress such as the improving of rigidity and the saving of weight. Other objects of research would be the bearings and ways for the tables and slides, the overall efficiency of the power transmission inside the tools, and improvements here upon. The precision of machine tools and their parts need physical analysis. The gripping and holding power of chucks and collets, and the dynamics of reciprocating parts for the purpose of reducing, and possibly eliminating shock and vibration also need much careful study. Investigation of the relative merits of Mechanical, Hydraulic and Electrical drives, their most adaptable fields of application, and similar investigations regarding hand operations versus machine operations should all be carefully considered. These are a few examples only and not a complete research program.

The field of research in machine tools and cutting tools covers independent research for the purpose of increasing our basic knowledge and also to yield solutions of specific problems of interest for individual manufacturing companies.

Race With Sound

(*Continued from page* 13)

to be structurally designed for speeds above Mach 1.18. It must be capable of full speed for from two to five minutes. It must be able to carry an additional 500 pounds of testing and recording instruments. Finally, it was to land and take off under its own power. The result of these requirements is the XS-1.

It must not be thought that the XS-1, or any other lesser known sonic aircraft, is a military weapon. Built for research alone, it is a veritable flying laboratory. It is fitted to the last available inch with every imaginable sort of instrument. Air pressure and strains are measured by 240 pressure orfices and 12 strain gages in the wing with an equal number covering the empanage. Temperature changes, acceleration, stability, and other factors in performance are all carefully measured. All information is preserved in three ways. A recording is made of all vocal observations made by the pilot. All instrument readings are constantly recorded on films. As a final precaution all results are telemetered to the ground, lest fire or crash destroy valuable research data.

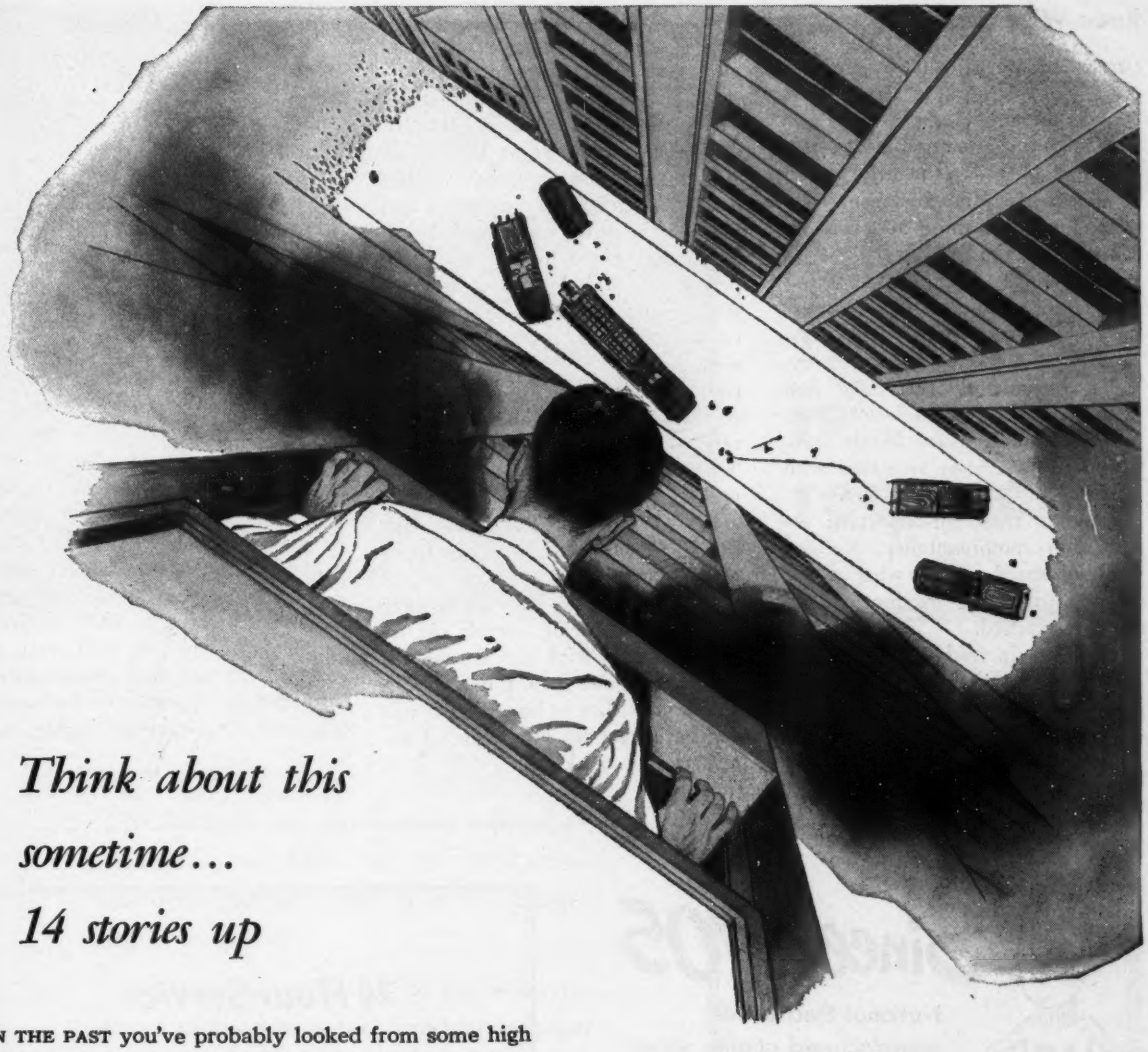
Transonic Exploration

Colonel Philip B. Klein of the AAF Air Material Command explained the real purpose of the XS-1 at a meeting of the Society of Mechanical Engineers in Chicago. He stated that the XS-1 was not designed for speeds faster than sound. Its job is "to explore the transonic region and provide actual flight data enabling us to build a supersonic plane in the near future." While the XS-1 has a potential speed of 1,700 m.p.m., these speeds are strictly potential, Klein warned. "For quite some time our flying will be done at subsonic speeds," he stated.

Subsequent flights of the XS-1 apparently proved Klein's statement. Put through a long series of exacting tests, it met all specified Army requirements. Further tests gave valuable data on certain "unknowns", but up to the late summer of 1947 Mach 0.8 was seldom exceeded. The public was slightly let down when their expectations of a record shattering dash were not fulfilled.

Meanwhile, nearly every prominent aircraft producer in the nation began to contribute to supersonic research. Most notable of these was th Douglas Company with its D-558 which quickly captured the world speed record of Mach 0.828. With all the proven and theoretical data at hand, Douglas designed and built the D-558-2, incorporating radically swept back wing and tail, knife-thin wings, and a combination of rocket and turbojet for power. By this time it was almost an accepted fact that projectile-like aircraft with only semblances of wings would be able to crash the dreaded sonic barrier. Several other designs which apparently rendered the XS-1

(*Concluded on page* 38)



Think about this sometime... 14 stories up

IN THE PAST you've probably looked from some high window, and wondered what would happen if you were trapped by fire. But the chances are you never thought it could really happen to *you!*

But it *could* and *might* happen to you. And here's how.

Granted that your favorite hotel is made of steel and concrete and it will not burn. It is "fireproof". But its contents *are not.* It is like a furnace, with fuel at the bottom—perhaps flammable wastes and stored goods of all kinds in the basement. And like a furnace, when ignited, the flame is at the bottom, but the heat goes to the top. Red hot gases surge through elevator shafts, vents and passageways, carrying destruction upward.

◇ ◇ ◇ ◇

YES, IT CAN HAPPEN TO YOU, or anyone, for as long as people are human and careless, there is no way to prevent such fires from *starting* . . .

But such fires can be *controlled.* Needless destruction and loss of life can be *prevented* by checking fire at the source, when it starts, with Grinnell Automatic Sprinkler Systems. Seventy years experience show that close to 100% of fires starting in buildings protected by Grinnell Sprinkler Systems are extinguished before doing material damage.

LOOK FOR THE GRINNELL SPRINKLER HEAD ON GUARD!

In hotels, schools, hospitals, theatres and factories, there is a moral obligation upon management for the utmost in protection of life and property. For your own sake ask about it in the hotel where you stop, the plant in which you work, the school your youngsters attend. Everywhere you go, look for famous Grinnell Automatic Sprinkler heads—your assurance of fire protection. Grinnell Company, Inc., Providence, Rhode Island.

GRINNELL

AUTOMATIC FIRE PROTECTION SYSTEMS

ENGINEERING GRADUATES HAVE FOUND ATTRACTIVE OPPORTUNITIES WITH GRINNELL

Race With Sound

(*Continued from page* 36)

obsolescent were in the construction stage.

First Supersonic Flight

Finally, a sudden and most unexpected end came to this brief period of high pressure pioneering in aeronautics. This heading appeared on the pages of an aircraft journal in December of 1947: "Bell XS-1 Makes Supersonic Flight!!" Details were quick to follow. In July tests, heavily shrouded in official secrecy, Bell's aeronautical "Test Tube" had been pushed up to Mach 0.90, then to Mach 0.92, then Mach 0.96. Speeds were always increased with extreme caution. Much suspense accompanied these all-important assaults on compressibility. No one knew or dared predict what would happen when the mythical Mach 1.0 was reached.

One day in mid November the XS-1 finally slid through the invisible sonic barrier and on into the supersonic region. Capt. Charles Yeager of the U.S.A.F., test pilot on the momentous flight, reported no undue difficulties. Problems, virtually accepted previously, failed to materialize. Several subsequent penetrations past Mach 1.0 were uneventful. Made at an altitude of 40,000 to 70,000 feet, these flights not only broke all existing speed and altitude records, but marked the beginning of the long awaited supersonic age. Conventional straight winged aircraft were proved practical and numerous research problems were solved. Never before had such carefully developed and well-founded theories been so completely shattered.

From this point forward "the sky is the limit." Sonic speed may be as a snail's pace by comparison with future developments. Colonel Klein has further stated: "So far as we know, there is no limit as to how fast a man-carrying aircraft can be made to fly." With this thought in mind, we move into a new era in aeronautics. Let us hope that it will not be a new era in the art of destruction of mankind.

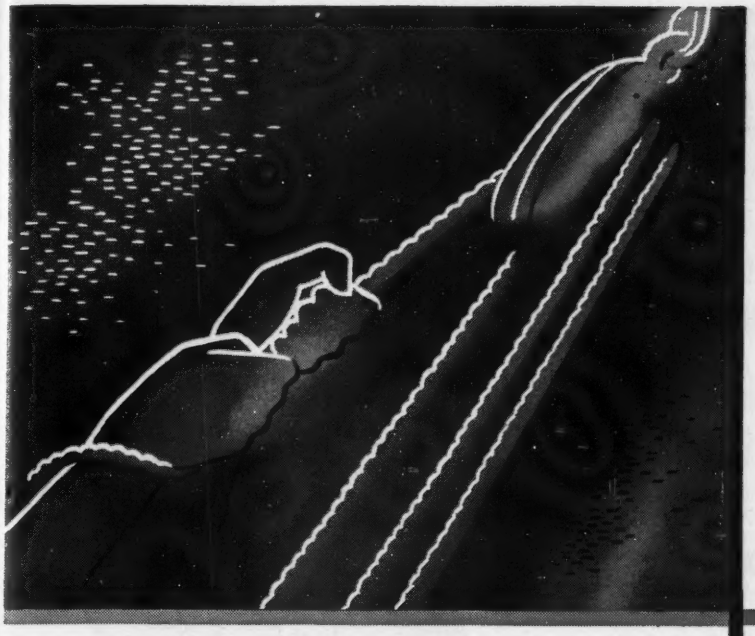
Long Playing Records

(*Continued from page* 24)

pared to that necessary for conventional records. Pickup weight on the record is six grams.

RCA decided before the war to embark on a reform of recording technique, and elected to make its greatest efforts in the direction of improving fidelity and of providing continuity by designing the record in conjunction with a new changing mechanism. Because of the changer, RCA did not have to use so low a speed as Columbia, and settled on 45 R.P.M., which gives up to 5⅓ minutes of playing time on a 6⅞-inch disc. This size record will be used for all purposes, for simplicity and standardization. RCA maintains about the same minimum recording diameter, in the neighborhood of 5 inches, as Columbia, so that its 35 per cent higher speed provides an opportunity for reproduction of somewhat higher fre-

(*Concluded on page* 44)



When sail trimming is required

No business can stay healthy without an occasional overhaul of its production set-up—particularly when a seller's market begins to quiver.

Molybdenum steels may be just what the doctor ordered to reduce production costs, and still maintain the product's reputation for consistent performance.

Send for our comprehensive 400-page book, free; "MOLYBDENUM: STEELS, IRONS, ALLOYS."

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS

Climax Molybdenum Company
500 Fifth Avenue • New York City

MOLY

C4

Prominent Engineers

Gene Hofmann

(*Continued from page* 17)

In his first year, Gene served on the Freshman House committee, won a letter in 150 pound crew, competed for basketball manager, and pledged Sigma Nu Fraternity. In his sophomore year he served as Jayvee basketball manager, graduating in '47 to varsity co-manager. He also went out for crew, and spent other spare hours working in the Straight Cafeteria.

Gene is a member of Tau Beta Pi, Wagon Wheels, and Scabbard and Blade and is secretary of Atmos, treasurer of Quill and Dagger, and a charter member of Pi Tau Sigma. He was rushing chairman of Sigma Nu this year.

As a descriptive geometry instructor, Gene now has a method, via the red pencil, of getting even with some of his freshman camp charges for all the practical jokes perpetrated last September. Seriously though, he has enjoyed teaching and his classes have liked him.

Upon his graduation in August, Gene plans to enter industry, being particularly interested in sales engineering and production management. The ENGINEER wishes him all success in his undertakings.

Wendel Kent

(*Continued from page* 17)

honorary, and Chi Epsilon, the civil engineering scholastic honorary, indicate a recognized ability in engineering. Another talent is demonstrated by his high standing in that honorable society of would-be "men of distinction", Pyramid.

Chief among his hobbies is sailing. Possessing a catboat and a membership in the Cornell Corinthian Yacht Club, he awaits the advent of warmer breezes that proclaim the season of renewed acquaintance with Cayuga.

Like all June graduates, he finds this business of working for a living staring him in the face, but unlike some he has an idea of what he wants to do. Although he has not taken a job, highway construction and bridge building, a special interest of long standing, is the field of his choice.

DU PONT Digest
For Students of Science and Engineering

TEN UNIVERSITIES TO BENEFIT BY GRANTS FOR UNRESTRICTED FUNDAMENTAL RESEARCH

With a view to stock-piling basic knowledge, the Du Pont Company has announced a program of grants-in-aid for the college year 1949-50 to 10 universities for unrestricted use in the field of fundamental research in chemistry.

The grants-in-aid of $10,000 each are to be used for research that has no immediate commercial goal. The universities themselves are to select the projects in which the grants will be employed, and results of the research are to be freely available for publication.

Du Pont's purpose in offering the grants is to help insure the flow of fundamental knowledge in science upon which the future industrial development of our country is so dependent. It is intended that the funds be utilized for such expenses as employing additional research personnel or lightening the teaching load of a professor who is eminently capable of research of a high order. They may also be expended for the purpose of obtaining supplies, apparatus or equipment.

This program of grants-in-aid is largely experimental. However, it is Du Pont's hope, should the program work out satisfactorily, to continue each grant for a period of five years.

The 10 universities to which grants-in-aid are being offered are California Institute of Technology, Cornell, Harvard, Massachusetts Institute of Technology, Ohio State, Princeton, Yale, Illinois, Minnesota and Wisconsin. Du Pont fellowships are also offered at these institutions.

77 DU PONT FELLOWSHIPS MADE AVAILABLE TO GRADUATE STUDENTS

Again in the academic year 1949-50, the Du Pont Company is awarding post-graduate and post-doctorate fellowships to universities throughout the country.

This is a continuation of the company's 30-year-old plan to encourage advanced studies in the fields of chemistry, physics, metallurgy, and engineering.

It is hoped that the plan will continue to help maintain the flow of technically trained men and women who will go into teaching and research work at the universities and into technical positions in industry. Some of them, as in past years, may come to work for Du Pont when they finish their studies, but there is no obligation to do so; fellowship holders are free to enter any field of activity they choose.

What Fellowships Provide

Each post-graduate fellowship provides $1,200 for a single person or $1,800 for a married person, together with an award of $1,000 to the university towards tuition and fees. Each post-doctoral fellowship provides $3,000 for the recipient and $1,500 to the university.

The students and their research subjects will be selected by authorities of the 47 universities participating. In this year's program, 45 of the post-graduate fellowships are in chemistry, 4 in physics, 15 in chemical engineering, 5 in mechanical engineering and 2 in metallurgy. There will be 6 post-doctoral fellowships as an incentive to those who would prefer to remain in academic work in order to obtain additional advanced training in chemistry.

Four of Many Outstanding Du Pont Fellowship Winners

STANLEY

MARVEL

WALKER

FAWCETT

Dr. Wendell M. Stanley, at University of California, is Chairman of the Department of Biochemistry in Berkeley and in the Medical School at San Francisco; Director of the Virus Laboratory. Bachelor's degree at Earlham College, 1926; M.S. at Illinois, 1927 and Ph.D. in Organic Chemistry, 1929. Honorary Doctor's degrees from five prominent American universities and the University of Paris. Has received more than 10 medals and awards for distinguished work in chemistry and biochemistry; co-recipient of the Nobel Prize in Chemistry in 1946. Du Pont fellow at Illinois in 1928-29.

Dr. Carl S. Marvel, Professor of Organic Chemistry at the University of Illinois since 1930, received his A.B. at Illinois Wesleyan University in 1915; A.M. at Illinois, 1916 and Ph.D. in Organic Chemistry, 1920; Sc.D. (honorary) at Illinois Wesleyan, 1946. President American Chemical Society, 1945; Director 1944-46. Has received numerous honors such as the Nichols Medal and memorial lectureships at outstanding universities. Du Pont fellow at Illinois in 1919-20. Consultant on Organic Chemistry to the Du Pont Company at present.

J. Frederic Walker is a Research Supervisor on formaldehyde products in the Electrochemicals Department. Trained at Massachusetts Institute of Technology. Awarded Bachelor's degree in Chemistry, 1925; Master's degree 1928, Ph.D. in Organic Chemistry, 1929. Author: "Formaldehyde Chemistry," "Organic Chemistry of Sodium," "History of Chemistry." Du Pont fellow in 1926-27.

Frank S. Fawcett is now doing synthetic organic research with Du Pont's Chemical Department. Received Bachelor's degree in Chemistry, Furman University, 1940; Master's degree, Pennsylvania, 1944; Ph.D. in Organic Chemistry, Massachusetts Institute of Technology, 1948. Du Pont fellow at M.I.T. in academic year 1947-48.

Techni Briefs

(*Continued from page 23*)

and now constitute a threat to the other trees in the forests of the northeastern part of the United States. If these trees could be made use of, this difficulty would be in part obviated.

The Bureau of Standards claims that the new paper made with the resin bond reduce the tendency to "pick" at the surface. Picking is a term used to describe the attraction of the paper running through a press for the wet printing surface. The new papers have a folding endurance ten times of that of ordinary paper and are very strong when wet. This research done was initiated during the war in a search for paper suitable for war maps.

New Water-repellent

The GE Chemical Department has processed a silicone derivative for use as a new water-repellent. This substance, which is quite similar to Dri-Film, the product presently on the market, can be used in communications equipment where dry apparatus is needed for quick efficient operation, can be sprayed or brushed on walls as an invisible waterproof coating, or can even be used to treat fishermen's dry-flies.

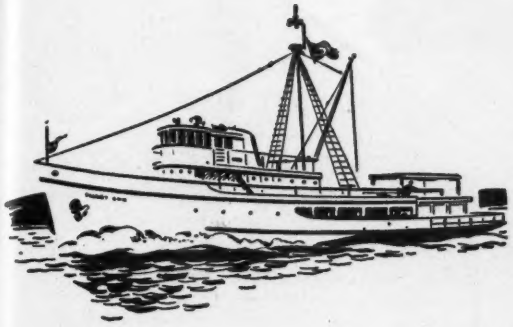
Theater Television

Theater television, at present still in the developmental stages, is nearing realization with two major processes under consideration. One form consists of direct projection through a reflective optical system by a standard kinescope, employing a high enough applied voltage to give sufficient brilliance to the image. The other method suggested for large-screen television is that of an intermediate film projection system which uses a film record of the television sequence. A process has been developed by Eastman Kodak in conjunction with RCA to cut the time lag in the latter system between signal reception and film projection to less than one minute. While the method of direct projection is less expensive and allows no time delay, the second gives the possibility of successive showings, editing, etc., and thus appears to have greater general applicability.

Portable Vibrometer

To measure vibrations in rotating machinery such as compressors, motors, pumps, and fans, the Recording Vibrometer has been developed by the General Electric Company. The vibrometer will record both the frequency and amplitude of vibrations over a range from 10 to 120 cycles per second. The record is made without ink on a moving strip of wax paper. The unit is very portable, about the size of a loaf of bread, and may be operated from normal 115 volt, 60 cycle, power supplies.

Another page for **YOUR BEARING NOTEBOOK**

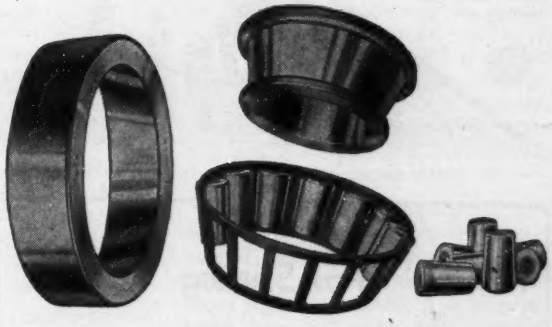


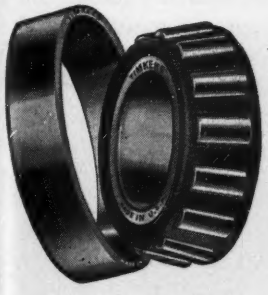
How to keep a hold cold

Both time and tuna are lost if the refrigeration unit breaks down while a fishing boat is at sea. Engineers insure dependability in sea-going ice machine compressors by specifying Timken® tapered roller bearings on crankshafts. Because of their tapered design, Timken bearings carry any combination of radial and thrust loads. With Timken bearings on the crankshafts, friction and lateral play are minimized. Shafts are held in rigid alignment. Wear and maintenance are reduced.

Why does TIMKEN® lead in bearing design?

The tapered roller bearing was pioneered by Timken and every important tapered roller bearing improvement since has been introduced by Timken. For example, Timken developed the one-piece multiple perforated cage to insure exact spacing of the rollers. And to provide positive roller alignment, Timken introduced wide area contact between the roll ends and the ribs. For almost fifty years this leadership in design has helped make Timken bearings first choice with engineers in every field.





TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

Want to learn more about TIMKEN bearings?

Some of the important engineering problems you'll face after graduation will involve bearing applications. If you'd like to learn more about this phase of engineering, we'll be glad to help. For additional information about Timken bearings and how engineers use them, write today to The Timken Roller Bearing Company, Canton 6, Ohio. And don't forget to clip this page for future reference.

NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ◐ AND THRUST —◎— LOADS OR ANY COMBINATION ✳

Long Playing Records

(*Continued from page* 38)

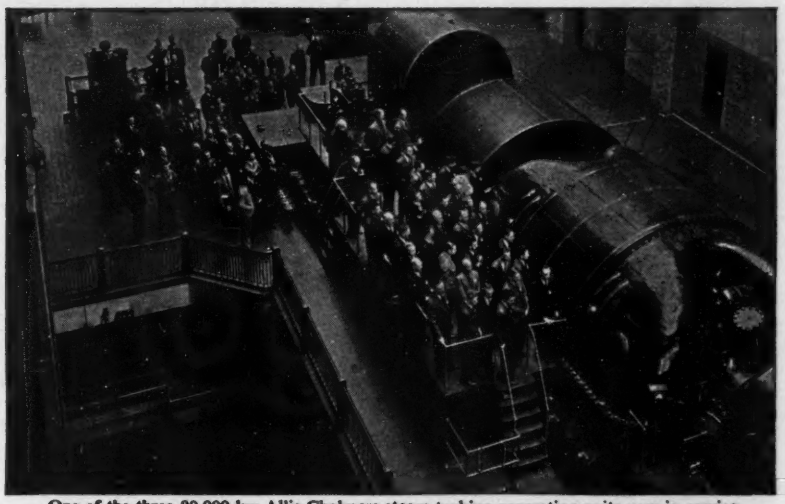
quencies without undue distortion. The actual relative performance, of course, depends on other variables also, such as groove displacement. The records are made of vinylite, and maximum groove spacing is held to 275 grooves per inch.

The adoption of a wholly new type of record provided the opportunity for designing a compact new record changer, which works from the inside rather than the outside. Since changer and records were designed to fit each other, the former could be made much more simple and reliable. There is a 1½-inch hole in the center of the record, instead of the usual ¼-inch hole, and this fits over a similar-sized center spindle on the changer. The label area of the record is thicker than either the recording area or the portion next to the spindle, so that the grooves never rub together and the changer blades do not have to force themselves between the records. The mechanism works very quickly and quietly, dropping each succeeding record into place in two seconds, without any chance of damage. The unit is small and much less complicated than changers for conventional records. Pickup weight on the record is five grams, and the tip of the sapphire stylus is one mil in radius. The records will be made in seven different colors according to types of music, and will be sold in transparent wrappers.

Change Your Mind...

Most of us have, at one time or another

by J. L. SINGLETON
Vice-Pres. and Director of Sales, General Machinery Division
ALLIS-CHALMERS MANUFACTURING CO.
(Graduate Training Course 1928)



One of the three 80,000 kw Allis-Chalmers steam turbine generating units now in service in a big mid-western power plant. A fourth unit is being built, and a fifth is on order.

You may be one of those men who knows exactly the sort of work he wants to do when he finishes engineering school. I did. I was going into straight engineering work. But I became a salesman.

J. L. SINGLETON

I've noticed since that it's not unusual for Graduate Training Course students at Allis-Chalmers to change their minds. Here, opportunities have a way of seeking out a man according to his ability. Sometimes these opportunities are in fields that he had not fully understood or considered before. There are so many kinds of work to do here that a man is almost sure to end up in work that will bring him the most in personal satisfaction and advancement.

Opportunities in Selling

For example—sales. Not every engineer is a salesman, but at Allis-Chalmers every salesman is an engineer. Engineering plays a vital part in the sale of a big steam turbine, a cement plant—or even a multiple V-belt drive.

There's a thrill in landing orders—really big ones, such as two 115,000 HP generators for Hoover Dam—all of the rolls and purifiers for the world's newest and most modern flour mill—the world's largest axial compressor for use in a supersonic wind tunnel, or volume sales of small motors, pumps and drives. Orders like these come through teamwork of engineering, manufacturing skill, high-level salesmanship and merchandising. It's good to be a member of such a team.

If you have ability and a leaning toward sales work, you'll have plenty of chance to test and develop it at Allis-Chalmers during your Graduate Training Course. Then you take your place in a Coast-to-Coast sales organization—perhaps even in a foreign office.

Many Fields Are Open

Or, maybe you'll change your mind. Research and development—or manufacturing—or design engineering may prove your field. The point I want to make is, all of these things are open to you at Allis-Chalmers. This company is in intimate touch with every basic industry: mining and ore processing, electric power, pulp and wood products, flour milling, steel, agriculture, public works.

The Graduate Training Course here doesn't hold you down. You help plan it yourself, and are free to change as you go along. You work with engineers of national reputation—divide your time between shops and offices—can earn advanced degrees in engineering at the same time.

Those are some of the things that appealed to me 23 years ago. They're still good.

Rotary Kilns are the most gigantic of all machines. Allis-Chalmers has designed and built kilns up to 475 feet in length, 12 feet in diameter—supplies all basic machinery for complete cement mills and processing plants.

Front-line man on the A-C team that designs, builds and sells basic machinery to all industry.

Write for details of the Allis-Chalmers Graduate Training Course — requirements, salary, advantages. Representatives may visit your school. Watch for date.

ALLIS-CHALMERS MFG. CO.
Milwaukee 1, Wisconsin

ALLIS-CHALMERS

College News

(*Continued from page 22*)

Tau Beta Pi

Mechanical Engineering

Robert C. Allen
Leo R. Bell
Frank B. Carder
Joseph M. Carter
Harry F. Cramer
Richard G. Elmendorf
Richard P. Feyk
Benedict J. Gaylo
Warren H. Heimer
Jack H. Hobson
Eugene S. Jacobs
Richard O. Leinbach
Charles A. Peek, Jr.
Robert W. Potter
Daniel K. Roberts
Francis W. Walker
Edward E. Zajac

Chemical Engineering

William D. Lawson
William M. Marcussen
Leo A. Sears
Donn E. Skoog
Marvin C. Soffen

Eta Kappa Nu

A student-faculty banquet, sponsored by Eta Kappa Nu, was held in the Terrace Room of Willard Straight Hall on March 1. Following introductory talks by Professors Joseph Tarboux and George Hallgren, the role of government in business was discussed. On March 22, members and their guests formed a discussion group which met at the Telluride house to hear a talk by Professor Credle.

Electrical engineers recently elected to Eta Kappa Nu include the following:

Herman Albertine
Douglas W. Anderson
Robert J. Burns
John C. Corbin
Ernest C. Dawson
Leon F. Fabbioli
Charles G. Gorss
Fred Himelfarb
Alan R. Honig
James C. Huntington
Max H. Kraus
William M. Lowerre
Erwin Lieff
George V. MacKain
Richard C. McCann
George C. McRae
Irving Ross
Robert C. Rustay
Edward F. Seymour

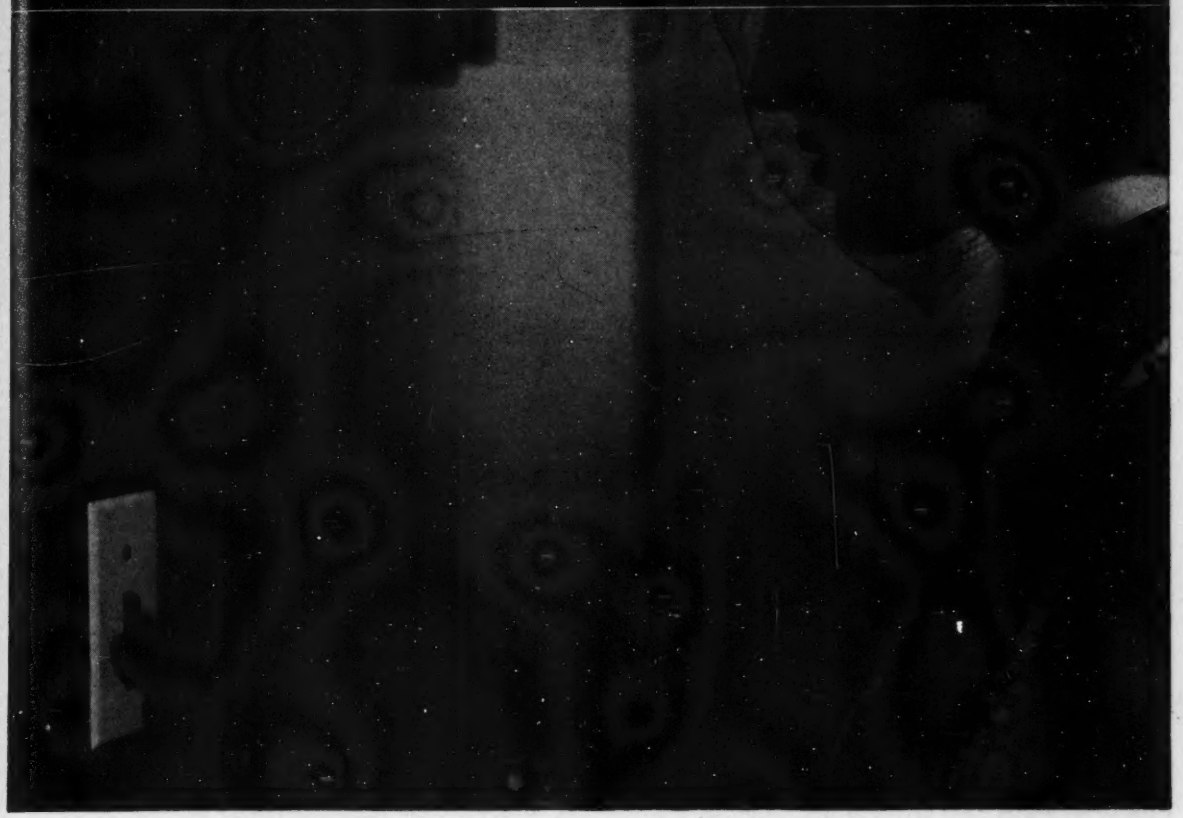
Rome Prize Fellowship

Henri V. Jova of Newburgh, N.Y., an undergraduate in the College of Architecture at Cornell University, has been awarded a Rome Prize Fellowship in architecture by the American Academy in Rome. Selection of an undergraduate for such an award is described as highly unusual.

Jova and Spero Paul Daltas, a practicing architect in Belmont, Mass., were chosen in a final competition conducted by the Academy among seven outstanding applicants, the announcement said. The fellowships are for one year beginning October 1, with a possibility of renewal for a second year.

Jova will receive the degree of Bachelor of Architecture at Cornell in June.

CORNING... DOES THE UNBELIEVABLE WITH GLASS



A new kind of light

where it will lead nobody knows

Soon it will be possible for you to step into your home or office and turn on a light that's different from any you've ever used before.

From a panel in the ceiling will come even, glareless rays to shine on your desk, your chair, your table—but never with uncomfortable brightness, never in your eyes.

The light itself will come from electric bulbs or tubes like those you use now. But it will *behave* far differently because it will shine through a ⅛-inch sheet of a new kind of glass—Fota-lite—a recent development of Corning Glass Works.

Formed inside this sheet is a crisscross pattern of strips of white glass extending through the full thickness of the glass. The squares enclosed by the white strips are crystal clear.

Light from the bulb above—shining through this patterned glass at slantwise angles—is diffused and causes no glare. You get an even, soft light through the entire room—as well as light channeled directly downward through the clear squares to the objects you need to see closely.

This new glass is made by mixing small amounts of rare metals in with the sand before it is melted to form glass. These materials make the whole sheet of glass photo-sensitive—through and through—so that any desired design (such as the one mentioned) may be formed inside the glass by a special process.

In fact, similar photo-sensitive glass is currently being used to print photographs in glass—pictures that can last for thousands of years.

Use of Fota-lite for indoor lighting is its first industrial application. Many other applications—such as its use in instrument panels for cars, in street lighting, and in illuminated signs—are being thoroughly explored.

In 98 years of glass-making Corning has developed glass into one of the most versatile engineering materials there is. There are more than 50,000 glass formulas on file at Corning, and the number is growing continually as new developments such as this photo-sensitive glass come out of the laboratory.

That's a good thing for you to remember. For some day, when you've picked the business you want to work in, one of these glass developments—or one now in the research stage—may be just the material you'll be looking for to improve a product or a process.

CORNING GLASS WORKS
CORNING, NEW YORK.

Alumni News

(*Continued from page* 21)

ning engineering tests of soils, and manufacturing soil testing equipment. The company is located in Evanston, Illinois.

Deceased

Albert L. Colston, C.E. '95, died recently at the age of seventy-six. He had been principal of the Brooklyn Technical High School since its inception at his urging.

Mr. Colston was born in Binghamton, N. Y., received his degree from Cornell, and spent four years as a government engineer in Hawaii, where he taught mathematics and drawing at Oahu College. He next taught applied mathematics at Tome Institute in Maryland, for three years.

In 1902, Mr. Colston started his many years of teaching in Brooklyn, where he joined the faculty of the Manual Training High School, and taught mechanical drawing and mathematics. He felt the need for a high school devoted primarily to technical studies, and in 1922 organized the Brooklyn Technical High School. In 1930, the school's new building was erected from plans worked out by Mr. Colston. He served as principal from 1922 to 1942, the time of his retirement.

Paul Messer, M.E. '94, retired engineer, died January 31, 1949, in New Haven, Conn., where he lived at 220 Part Street. From 1897-1926 he was with American Trading Co. in Japan and China; from 1926-40, in England, France and Germany for the Radio Corp. of America; and from 1942-46, he was with the Reconstruction Finance Corp.

Ailyn Augustus Packard, B.S. in Arch. '86, who retired in 1947 as engineer of the 5th district of the Federal Works Agency, died in December, 1948. He lived at 7069 Eastlake Terrace, Chicago, Ill. Packard entered Federal service in 1899 and built more than 1,000 government buildings.

The Cornell Engineer
Ithaca, New York

Gentlemen:

I have been advised by Mr. Charles P. Frost that the February 1949 issue of the CORNELL ENGINEER notes as follows:

> **William P. Stein, M.E. '44,** is sales manager of the Bar-Ray Products, Inc., manufacturers of X-ray accessories in Brooklyn, New York.

While it is true that the undersigned is Sales Manager of Bar-Ray Products and that we are pioneers in the field of x-ray accessories and radiation protection, I do wish to call to your attention the fact that I was graduated from the Arts School in 1942. The closest I came to Engineering School was taking a final exam in the Baker Laboratory, not my pleasantest Cornell experience.

Sincerely yours,
William P. Stein

"Sticks and stones may break my bones . . ." (Ed. note)

THE HYDROSTATIC TEST

Nobody can buy a length of cast iron pipe unless it has passed the Hydrostatic Test at the foundry. Every full length of cast iron pipe is subjected to this test under water pressures considerably higher than rated working pressures. It must pass the test or go to the scrap pile.

The Hydrostatic Test is the final one of a series of routine tests made by pipe manufacturers to assure that the quality of the pipe meets or exceeds the requirements of standard specifications for cast iron pressure pipe.

Few engineers realize the extent of the inspections, analyses and tests involved in the quality-control of cast iron pipe. Production controls start almost literally from the ground up with the inspection, analysis and checking of raw materials—continue with constant control of cupola operation and analysis of the melt—and end with inspections and a series of acceptance and routine tests of the finished product.

Members of the Cast Iron Pipe Research Association have established and attained scientific standards resulting in a superior product. These standards, as well as the physical and metallurgical controls by which they are maintained, provide assurance that cast iron pipe installed today will live up to or exceed service records such as that of the 130-year-old pipe shown.

Cast iron pipe is the standard material for water and gas mains and is widely used in sewage works construction. Send for booklet, "Facts About Cast Iron Pipe." Address Dept. C., Cast Iron Pipe Research Association, T. F. Wolfe, Engineer, 122 So. Michigan Ave., Chicago 3, Illinois.

Section of 130-year-old cast iron water main still in service in Philadelphia, Pa.

CAST IRON PIPE SERVES FOR CENTURIES

STRESS and STRAIN...

The father's tone of voice was severe. "Young man," he said, "do you think you should be taking my daughter to night clubs all of the time?" "Indeed not!" the boy answered, then added hopefully, "Let's try to reason with her."

* * *

Textbook Style: *"The efficacy of hydrochloric acids is indisputable, but the corrosive residue is incompatible with metallic permanence."*
Lab Report Style: *"Don't use hydrochloric acid for cleaning pipes. It eats hell out of them."*

* * *

"Do you know her to speak to?"
"Only to talk about."

* * *

"Doc," said the old mountaineer, leading a gangling youth into the presence of the village medico. "I want you should fix up my son-in-law. I shot him in the leg yesterday and lamed him up a mite."
"Shame on you, shooting your son-in-law!" scolded the doctor.
"Wal, Doc," rejoined the mountaineer, "he warn't my son-in-law when I shot him."

* * *

Most engineers call a spade a spade . . . until they drop one on their toes!

* * *

"Why should a college man kill himself?"
"Oh, lots of reasons. Women, and wine among other things."
"And if he has none of these?"
"Still more reason why he should."

* * *

Many students are like processed coffee — 98 per cent of the active ingredients have been removed from the bean.

You can't kiss a girl unexpectedly. The nearest you can come to it is to kiss her sooner than she thought you would.

* * *

"It's quite simple," explained one of the juniors in EE 4216, "to hook up an electric power circuit. We merely fasten leads to the terminals and pull the switch. If the motor runs, we take our readings. If it smokes, we sneak it back and get another one."

* * *

The car skidded around the corner, jumped in the air, knocked down a lamp post, smacked three cars, ran against a stone fence, and stopped. A girl climbed out of the wreck. "Darling," she exclaimed, "that's what I call a kiss!"

* * *

Super sophisticated co-ed: "And how does one begin writing?"
Bored author: "From left to right."

* * *

O Engineers, with hairy ears,
Designing dams and ditches;
Controlling floods and blowing suds
And never reaching riches.
When you want fun your tastes
don't run
To graphs and mathematics,
But to a bar, not too far,
And ballroom acrobatics.
You make surveys of waterways
And plan for integration;
But H_2O to gin that's sloe
You add with moderation.
With stress and strain you ascertain,
The ways to make frames rigid;
Then spend the night, till broad
daylight,
In making dames less frigid.
O Engineers have hairy ears—
I find them most endearing—
But awfully odd, because by God,
They don't like engineering.

A Vetsburg engineer was discovered by his wife one night standing over his baby's crib. Silently, she watched him. As he stood looking down at the sleeping infant, she saw in his face a mixture of emotions —rapture, doubt, admiration, despair, ecstasy, incredulity. Touched and wondering alike at this unusual parental attitude and the conflicting emotions, the wife, with eyes glistening, slipped her arms around him.
"A penny for your thoughts," she said in a tremulous voice.
He blurted out, "For the life of me, I can't see how anybody can make a crib like that for three forty-nine."

* * *

A Civil E. lies on the floor,
He tried to slam a swinging door.

* * *

A good beginning and a good end make a good speech—if they come close enough together.

* * *

"Your wife needs a change," said the doctor. "Salt air will cure her."
The next time the physician called he found the Scotchman sitting by her bedside, fanning his wife with a herring.

* * *

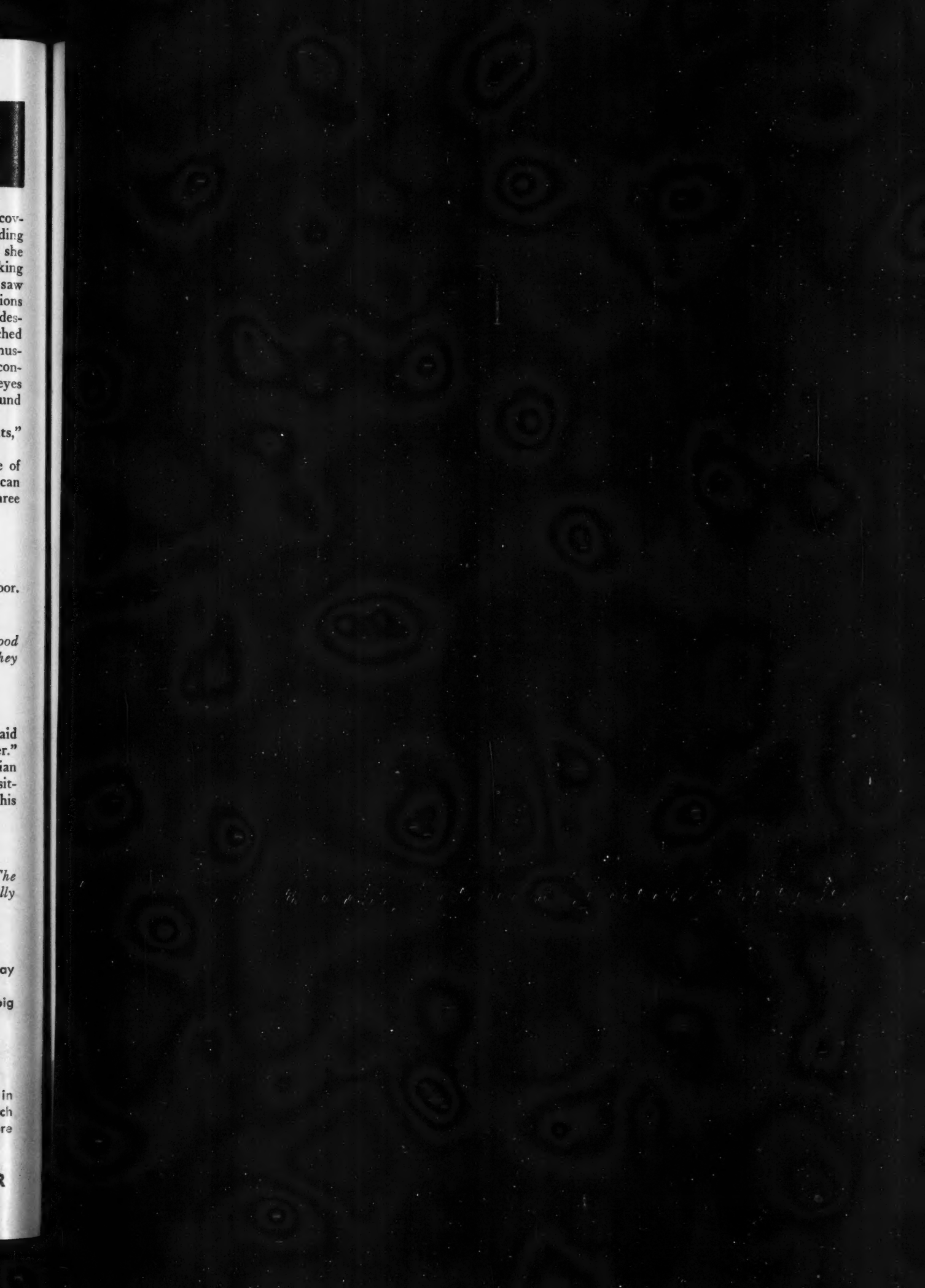
Civil Service Regulations: *"The death of an employee automatically ends his term of employment."*

* * *

Here's to the wings of love, may
they never moult a feather
Till your little shoes and my big
boots
Are under the bed together.

* * *

Don't worry about working in small towns, men! There isn't much to see, but what you can hear more than makes up for it!



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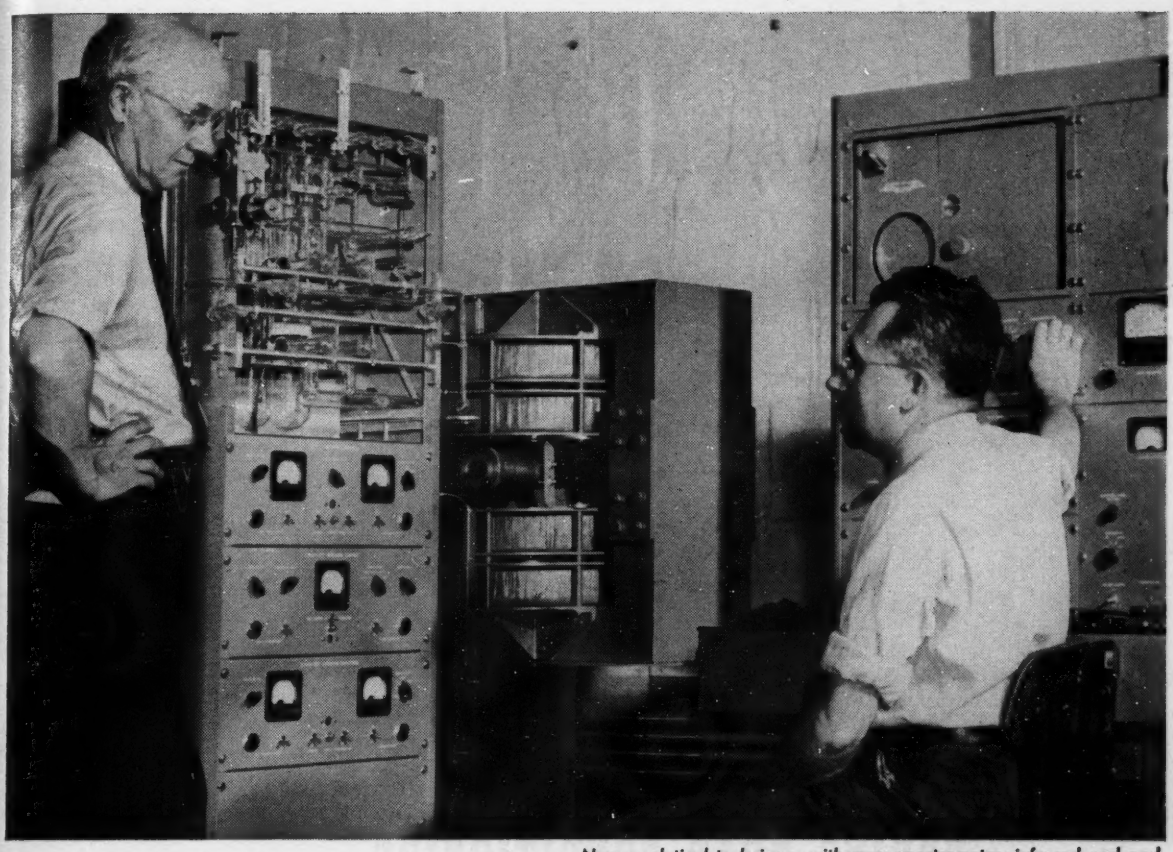


New analytical techniques with mass spectrometer, infrared and pod equipment. Refinery Chief Chemist G. Lansing, Washington & Jefferson, '11, Cincinnati '17, J. A. Simpson, N. Y. U. '38, Stevens '43.

What should a man work For?...

Put that question to either of the men shown here, and he'd answer about like this:

"Well, you could say a man works for a living, but there's more to it than just that. A man has his self-respect to keep. He wants to work at a job he likes. He wants to do something useful. He wants fair pay and steady hours—with some time to himself and his family. He wants a chance to get ahead and he wants to save some money. And he wants some security in case of accident or sickness. Then, when his working years are done, he wants to know he can retire on an annuity."

Today, in Esso Standard Oil Company, 28,000 men and women have jobs which offer exactly these things.

They have such jobs because of a company policy that was set up over 30 years ago—and developed side-by-side with our workers ever since. It is a policy based on the belief that the heart of a business is its people—that the best possible jobs attract the best possible workers.

Workers in this company today have everything outlined in the statement above—including vacations with pay, sickness benefits, cash savings in a Thrift Plan, and the opportunity to retire with income for life.

Our 28,000 workers, for instance, have now been with us on the average for 12 years—8,400 of them more than 20 years.

But this policy hasn't grown from "generosity" alone. It's a practical, common-sense *business* policy, and a good one. Because we know that the best way for Esso Standard to help meet the growing oil needs of the world is . . . by doing our best to help our workers get "the things a man works for."

Esso

ESSO STANDARD OIL COMPANY

The Early Birds Are Out...

TIME FOR SPRING ROAD CONDITIONING

WITH Columbia Calcium Chloride

Calcium Chloride's remarkable affinity with water is put to good use in conditioning secondary roads, driveways, tennis courts and recreation areas. Spring and summer treatment consists of spreading the flakes over the surface . . . the chemical helps the subsoil to retain moisture, prevents cracking and formation of dust, provides firmer, smoother surfaces requiring less maintenance. In winter, calcium chloride mixed with sand or cinders is used to skidproof icy roads and walks.

These treatments are but a few of numerous uses of Calcium Chloride. Other important commercial applications include refrigeration, concrete curing, dust and freeze-proofing of coal and air dehumidifying. Columbia is one of the leading producers of Calcium Chloride, as well as Chlorine Caustic Soda, Soda Ash and other alkalies and related chemical products. Pittsburgh Plate Glass Company, Columbia Chemical Division, Fifth at Bellefield, Pittsburgh 13, Pa.

COLUMBIA CHEMICALS

PPG

PAINT · GLASS · CHEMICALS · BRUSHES · PLASTICS

PITTSBURGH PLATE GLASS COMPANY

Photography can make this page

this  small

IT'S DONE WITH MICROFILM MAGIC

TINY AS IT IS, the little rectangle above is this page in black and white—as it appears on microfilm. Everything there, condensed to a mere spot, but ready to be brought back full size with all its features intact. For photography can reduce tremendously without losing a detail.

As a business or professional man, you can utilize photography's reducing ability in any of many important ways.

You can utilize it to save space . . . to speed reference. With Recordak microfilming, you can "debulk" files 99% . . . keep the records at hand for quick viewing, full size, in a Recordak Reader.

You can utilize photography to make sales presentations more complete, more resultful. With motion pictures, you can "pack" a plow, a plant, a whole process into a small can of film . . . travel it where you will, show it off "large as life" and much more dramatically.

Only a suggestion . . . this . . . of what photography can do because it is able to condense. And because it has many other unique characteristics as well, photography is becoming an increasingly important tool all through science, business, and manufacturing.

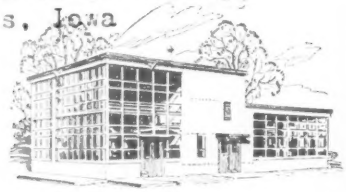
Whenever you want to improve methods of recording, measuring, testing, teaching, or countless other functions, be sure to consider the unusual abilities and advantages of photography.

Eastman Kodak Co., Rochester 4, N. Y.

Functional Photography

—is advancing business and industrial technics.

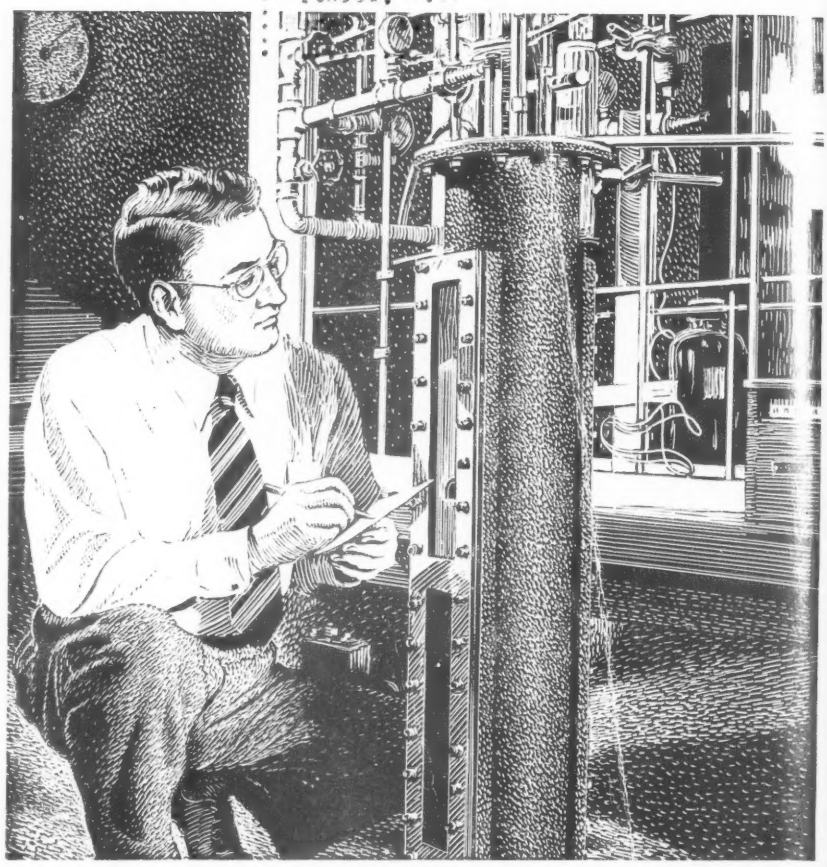
Kodak



NEW LABORATORY UNIT, *part of G-E Research Laboratory, is the center of General Electric research into such low-temperature phenomena as . . .*

SUPER-FLUIDITY *of helium—meaning that at near-absolute zero it loses its viscosity, can spin forever . . . and*

SUPER-CONDUCTIVITY—*the loss of all electrical resistance by some materials below about 15° absolute.*



Near absolute zero, matter does strange things . . .

AT 455 degrees below zero Fahrenheit, liquid helium becomes a "superfluid." That is, it loses its viscosity; if it were to be set in motion like stirred coffee spinning in a cup, part of it would theoretically continue to spin forever.

It also becomes a "super-wetting" agent, meaning that it will creep up the sides of a container and flow over the edge.

Other types of matter develop the property of "super-conductivity." Columbium-nitride, for example, loses all electrical resistance below 15 degrees absolute. If an electric current were set in motion in a closed loop of this substance, it would in theory flow indefinitely.

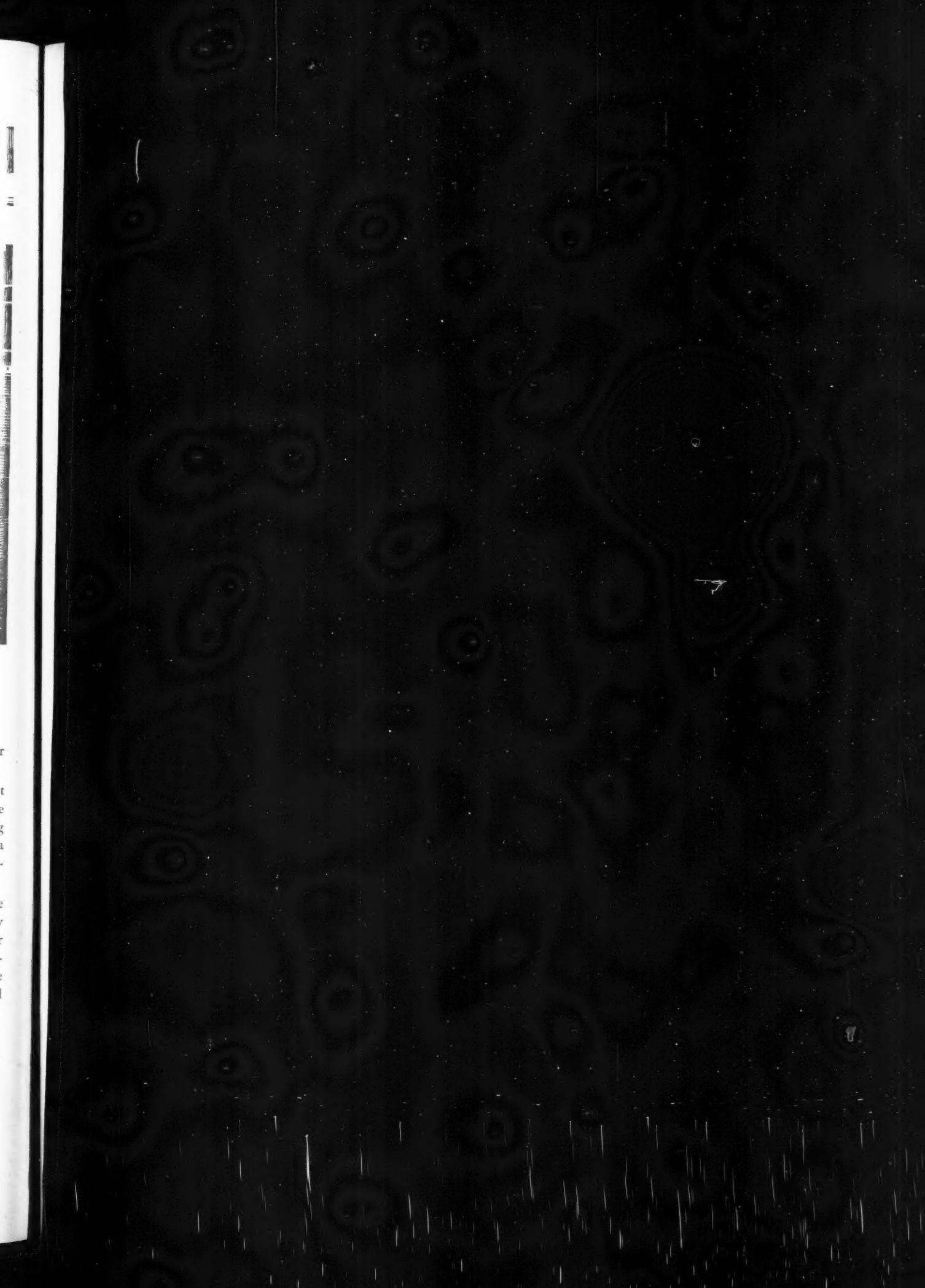
These are some of the facts of cryogenics—the study of low-temperature phenomena—into which a group of young General Electric scientists are directing their investigations.

So far their studies are in only the earliest stages. But already the facts of this nether world of temperature have aroused enough interest that with the building of a new Research Laboratory near Schenectady, a $250,000 laboratory unit has been especially constructed to aid and amplify their work.

Through its emphasis on research and creative thinking, through encouraging fertile minds to follow their own imaginative bent and by implementing their work with the best available facilities, General Electric remains "a place where interesting things are happening," and stays in the forefront of scientific and engineering development.

You can put your confidence in—

GENERAL ELECTRIC



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